DESTRUCTION OF CHEMICAL MUNITIONS AT PUEBLO CHEMICAL DEPOT, COLORADO

FINAL ENVIRONMENTAL IMPACT STATEMENT

March 2002

PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION

ABERDEEN PROVING GROUND, MD 21010-4005

LEAD AGENCY: DEPARTMENT OF THE ARMY, PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION

TITLE OF PROPOSED ACTION: DESTRUCTION OF CHEMICAL MUNITIONS AT PUEBLO CHEMICAL DEPOT, COLORADO

AFFECTED JURISDICTION: PUEBLO COUNTY, COLORADO

PREPARER:

COL CHRISTOPHER F. LESNIAK
Project Manager for Chemical Stockpile Disposal

PROPONENT:

JAMES L. BACON
Program Manager for Chemical Demilitarization

APPROVED BY:

LTC JOHN DRIFTMIER
Commander
Pueblo Chemical Depot

APPROVED BY:

RAYMOND J. FATZ
Deputy Assistant Secretary of the Army (Environment, Safety and Occupational Health), OASA (I&E)

DOCUMENT DESIGNATION: FINAL ENVIRONMENTAL IMPACT STATEMENT

ABSTRACT: Public Law 99-145 and subsequent related legislation requires destruction of the U.S. stockpile of lethal unitary chemical agents and munitions. Furthermore, in 1993 an international treaty, the Chemical Weapons Convention (CWC), was signed by 65 nations, including the United States. The CWC, which set the deadline for completing destruction of chemical weapons as 10 years following ratification by the required number of nations, received the necessary ratifications on April 29,1997. Thus, the international deadline for destruction of chemical weapons as April 29, 2007. The Army Chemical Stockpile Disposal Program has prepared this Final Environmental Impact Statement (FEIS) to assess the potential health and environmental impacts of the construction, operation, and closure of a facility to destroy the chemical agent and munitions stored at Pueblo Chemical Depot (PCD), Colorado.

Four alternatives are addressed in this FEIS for possible use in destruction of the PCD stockpile: (1) baseline incineration, which is currently in use by the Army at Deseret Chemical Depot (DCD), Utah and was used by the Johnston Atoll Chemical Agent Disposal System (JACADS) to destroy the entire stockpile on Johnston Atoll; (2) modified incineration, which is based on lessons learned at JACADS and DCD; (3) chemical neutralization followed by biotreatment, a developing technology that would be initially operated as a pilot test facility; and (4) chemical neutralization followed by super critical water oxidation, which is also under development and would be initially operated as a pilot test facility. The latter two alternatives are also being evaluated in a separate DEIS prepared by the Army Assembled Chemical Weapons Assessment Program (ACWA) as part of four chemical neutralization technologies being considered for pilot testing at PCD and three other chemical munitions storage locations. The data and information obtained from testing and full-scale operation of the incineration technology, and available data and information from on-going studies of the neutralization technologies provided by ACWA are analyzed and compared to the extent possible in this FEIS.

TABLE OF CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

AADT	average annual daily traffic
ac-ft	acre-feet
ACAMS	automatic continuous air monitoring system
ACW	assembled chemical weapons
ACWA	Assembled Chemical Weapons Assessment
ANAD	Anniston Army Depot
ANL	Argonne National Laboratory
APG	Aberdeen Proving Ground
AQCR	Air Quality Control Region
AR	Army Regulations
AWS	ammunition workshop
BGAD	Blue Grass Army Depot
BLM	Bureau of Land Management
BRA	Brine Reduction Area
BZ	a nonlethal, but incapacitating, agent
°C	degrees Celsius
CAA	Clean Air Act
CAIRA	chemical accident/incident response and assistance
CAMDS	Chemical Agent Munitions Destruction System
CAS	Chemical Abstracts Service
CBDCOM	Chemical Biological Defense Command
CDF	Chemical Destruction Facility
CDPHE	Colorado Department of Public Health and Environment
CDTF	Chemical Demilitarization Training Facility
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CHB	container-handling building
cm	centimeter
CML	conservative most likely; a meteorological condition
CNHP	Colorado Natural Heritage Program
CO	(1) Colorado (2) carbon monoxide
CONUS	continental United States
CPRP	Chemical Personnel Reliability Program
CSDP	Chemical Stockpile Disposal Project
CSEPP	Chemical Stockpile Emergency Preparedness Program
CWC	Chemical Weapons Convention
d	day

DAC	Defense Appropriations Conference
DAAMS	depot area air monitoring system
dB	decibels
dB(A)	decibels (on the A-weighted scale)
DCD	Deseret Chemical Depot
DEIS	Draft Environmental Impact Statement
DEMIL	demilitarization
DFS	deactivation furnace system
DHHS	U.S. Department of Health and Human Services
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DPE	demilitarization protective ensemble
DRE	destruction and removal efficiency
DRMO	Defense Reutilization Management Office
dscm	dry standard cubic meter
DUN	dunnage incinerator
D2PC	atmospheric dispersion model computer program
ECF	Entry Control Facility
ECR	Explosive Containment Room
EIS	Environmental Impact Statement
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act
EPGA	effective peak ground acceleration
EPZ	Emergency Planning Zone
ERCP	Emergency Response Concept Plan
°F	degrees Fahrenheit
FDA	U.S. Food and Drug Administration
Fed. Regist.	*Federal Register*
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FPEIS	Final Programmatic Environmental Impact Statement
ft	foot
FWPCA	Federal Water Pollution Control Act
FWS	U.S. Fish and Wildlife Service
GA	chemical nerve agent, also called Tabun
gal	gallon
GB	chemical nerve agent, also called Sarin
g	grams
GLD	Gross Level Detector
GPL	General Population Limit
Gwh	gigawatt hour
H	chemical blister agent, also generally called mustard
ha	hectare
HC1	hydrogen chloride
HD	blister type agent, also called mustard agent

HEPA	high efficiency particulate air
HG	mercury
HI	hazard index
HQ	hazard quotient
hr	hour
HT	chemical blister agent, mixture of HD and an organic compound
HVAC	heating, ventilation, air conditioning
HWC	hazardous waste combustors
ICAGRS	Interim Corrective Action Groundwater Remediation System
ICBO	International Council of Building Officials
ICCB	intergovernmental consultation and coordination boards
IDLH	Immediately Dangerous to Life and Health
ISCST3	Industrial Source Complex Short-Term Model
in	inch(es)
JACADS	Johnston Atoll Chemical Agent Disposal System
kg	kilogram
kV	kilovolt
kg/hr	kilogram per hour
km	kilometer
kWh	kilowatt hour
L	(1) liter
	(2) Lewisite
L_{dn}	loudness level
lb	pound(s)
LIC	liquid incinerator
LOS	level of service
LPG	liquified petroleum gas
m	meter
MACT	Maximum Achievable Control Technology
MAVs	modified ammunition vans
Mb	body wave magnitude
MCE	maximum credible event
MCL	maximum concentration level
MDB	Munitions Demilitarization Building
mg	milligrams
mi	mile(s)
min	minute
mm	millimeter
MPF	metal parts furnace
mph	mile(s) per hour
mpl	maximum permissible limit for demilitarization protective ensemble
µg	microgram
µm	micrometer
Mscf	million standard cubic feet
Mscm	million standard cubic meter

NAAQS	National Ambient Air Quality Standards
NaOCl	sodium hydroxide
NaOH	sodium hypochlorite
NECD	Newport Chemical Depot
NEPA	National Environmental Policy Act
ng	nanograms (billionths of a gram)
NHPA	National Historic Preservation Act
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOA	notice of availability
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NSCM	non-stockpile chemical materiel
NWA	national wilderness area
NWR	national wildlife refuge
O_2	oxygen
O_3	ozone
ONC	on-site container
ORNL	Oak Ridge National Laboratory
OVT	operational verification testing
PAD	Pueblo Army Depot
PAS	pollution abatement system
PAZ	protective action zone
Pb	lead
PBA	Pine Bluff Arsenal
PCB	polychlorinated biphenyls
PCD	Pueblo Chemical Depot
PDA	Pueblo Depot Activity
PDADA	Pueblo Depot Activity Development Authority
PFS	particulate filtration system
PGA	peak ground acceleration
PM-10	particulate matter less than 10 micrometers in diameter
PM-2.5	particulate matter less than 2.5 micrometers in diameter
PMB	Personnel and Maintenance Building
PMCD	U.S. Army’s Program Manager for Chemical Demilitarization
POD	Pueblo Ordnance Depot
ppm	parts per million
PSD	prevention of significant deterioration
PUB	Process Utilities Building
Pub. L	Public Law
RCRA	Resource Conservation and Recovery Act
RFP	request for proposals
RMA	Rocky Mountain Arsenal
ROD	Record of Decision

RTV	rational threshold values
s	second
SAAQS	State Ambient Air Quality Standards
SARA	Superfund Amendments and Reauthorization Act of 1986
SBCCOM	Soldier Biological and Chemical Command
SCBA	self contained breathing apparatus
scfh	standard cubic feet per hour
SCWO	supercritical water oxidation
SEL	Source Emission Limit
SHPO	State Historic Preservation Officer
SLERA	screening-level ecological risk assessment
SO_2	sulfur dioxide
SPL	sound pressure level
TCP	traditional cultural property
TDG	thiodiglycol
TNT	Trinitrotoluene
TOX	toxic cubicle
TPY	tons per year
TSCA	Toxic Substance Control Act
TSDF	treatment, storage, and disposal facility
TSP	total suspended particulates
TTC	Transportation Technology Center
TWA	time weighted average
UMCD	Umatilla Chemical Depot
USACHPPM	U.S. Army Center for Health Promotion and Preventative Medicine
USACOE	U.S. Army Corp of Engineers
USAEHA	U.S. Army Environmental Hygiene Agency
USATAHMA	U.S. Army Toxic and Hazardous Materials Agency
USGS	U.S. Geological Survey
VOC(s)	volatile organic compounds
VX	chemical nerve agent
WC	worst case (meteorological condition)

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

Under Congressional directive (Public Law 99-145) and an international treaty called the Chemical Weapons Convention (CWC), the U.S. Army is destroying the nation's stockpile of lethal chemical agents and munitions. The U.S. Army's Program Manager for Chemical Demilitarization (PMCD) has prepared this Final Environmental Impact Statement (FEIS) to assess the potential health and environmental impacts of the design, construction, operation and closure of a facility to destroy the types chemical munitions stored at Pueblo Chemical Depot (PCD) Colorado. The PCD stockpile consists of mustard agent (types HD and HT) contained in 155-mm and 105-mm artillery projectiles and in 4.2-in. mortar rounds. The specific goal of the current analysis is to identify and compare the potential environmental impacts among the alternatives that could accomplish the destruction of the stockpile at PCD in compliance with the CWC.

This Executive Summary presents the key findings of the FEIS for each of the environmental impact areas. Table 3.2 provides an additional level of detail and comparison of the alternatives that may be helpful to the reader in reviewing the summary.

ES.2 PROPOSED ACTION

Four alternatives are addressed in this FEIS for possible use in destruction of the PCD stockpile: (1) the baseline incineration process which was used by the Army at the Johnston Atoll Chemical Agent Disposal System (JACADS) to destroy the stockpile on Johnston Island in the Pacific Ocean, and is currently in use at Deseret Chemical Depot (DCD) near Tooele, Utah; (2) a modified incineration process, which is based on lessons learned at JACADS and DCD; (3) chemical neutralization followed by supercritical water oxidation (SCWO); and (4) chemical neutralization followed by biotreatment. If either of the two neutralization alternatives is selected, it would initially be operated as a pilot test facility before beginning full-scale operations. As required by regulations of the President's Council on Environmental Quality (CEQ), the no action alternative (i.e., continued storage of the PCD stockpile) is also addressed.

Under a Congressional directive, provided through Public Laws 104-201 and 104-208, the Department of Defense (DOD) has also created the Assembled Chemical Weapons Assessment (ACWA) Program. The Program Manager for ACWA is required to bring at least two technologies to the demonstration stage.

In 1999, ACWA selected the two neutralization alternatives listed above for further evaluation. ACWA is currently considering the pilot testing of neutralization with SCWO and neutralization with biotreatment at one or more of four facilities: PCD, Anniston Army Depot (ANAD), Alabama, Blue Grass Army Depot (BGAD), Kentucky, and Pine Bluff Arsenal (PBA), Arkansas. Additional neutralization technologies are being considered by ACWA for possible implementation at ANAD, BGAD, or PBA. A DEIS has been published by ACWA to evaluate and compare the potential impacts of those options. These two separate analyses serve complementary but distinct purposes. The ACWA DEIS is distinct from this PMCD FEIS for PCD in that its emphasis is on the feasibility of pilot testing one or more of the demonstrated and approved ACWA neutralization technologies, considering the unique characteristics of the four alternative installations.

This PMCD FEIS provides information on the environmental impacts of the four alternatives to aid in decision making concerning the technology to be used for destruction of the chemical munitions stockpile at PCD.

The results of the analyses presented in this Final Environmental Impact Statement (FEIS) show that any of the four chemical munitions destruction alternatives would be environmentally acceptable for destruction of the stockpile at Pueblo Chemical Depot. Neutralization with biodegradation is the agency's preferred alternative. The Army will continue to look for ways, to accelerate the process. Additional NEPA documentation will be completed as required. Following a 30-day comment period on this FEIS, the Department of the Army, on behalf of the Department of Defense, considering the results of this EIS along with other factors including cost, schedule, and public opinion, will publish the Record of Decision in the Federal Register.

ES.3 DESTRUCTION ALTERNATIVES

The destruction of the chemical weapons stockpile at PCD by implementation of any of the four alternatives would take place in structures designed to prevent release of mustard agent to the environment. Disassembly, preparation for destruction, and destruction of energetics would be carried out in an explosion containment area. The overall structure would be designed for agent containment using features such as air locks and negative differential air pressure.

Disassembly of the munitions for baseline incineration would involve separation of all the energetics from the munition, followed by draining the mustard agent from the munitions for incineration. After disassembly, the chemical munitions bodies, energetics, and mustard agent would be thermally treated in different types of incinerators.

With modified incineration, agent would not be drained from the munitions. The reconfigured munitions would be frozen and the fuze adapter would be pressed into the agent cavity to access the mustard agent. After disassembly, the chemical munitions and mustard agent would be thermally treated in the same incinerator. The energetics would be shipped to a permitted treatment, storage, and destruction facility or treated on-site.

Under the neutralization alternatives, the munitions would first be disassembled using a process similar to that of the baseline incineration system. For the SCWO alternative, agent access would be accomplished by freezing and cryofracture of the munitions. Under the biotreatment alternative the liquid chemical agent would be drained from the munition bodies. Following disassembly, the energetics and mustard agent would be chemically neutralized by using water and caustic. The resulting chemicals would then be further treated by using either biotreatment (conceptually similar to the process used in a sewage treatment plant), or by very high temperature and pressure in SCWO units.

The no action alternative would involve continued storage of the chemical munitions stockpile at PCD. Current safety procedures for storage and maintenance would continue to be followed, including monitoring and surveillance.

ES.4 ENVIRONMENTAL IMPACTS

PCD is located in southeastern Colorado, approximately 14 miles east of the center of the City of Pueblo in Pueblo County, and about (1 mi) north of the Arkansas River. The installation encompasses approximately 23,000 acres and includes a variety of buildings, structures, and undeveloped areas.

ES.4.1 LAND USE

Construction and operation of an incineration or neutralization facility would not have significant impacts on on-post land use because land disturbance would be limited to a relatively small area within the larger area of PCD that has been reserved for chemical demilitarization activities. The destruction facility would have a footprint of approximately 20 acres, but up to 85 acres could be disturbed when all utility corridors and running routes are included. Construction activities would be compatible with existing land uses and with the land uses proposed for the northeastern portion of PCD.

ES.4.2 WATER SUPPLY AND USE

Due to the amount of process water that would be required, water use at PCD would increase substantially during the operation of either incineration or neutralization facilities. The historic demand for groundwater at PCD has decreased in recent years due to workload reductions; thus, the total demand for groundwater during destruction facility operations would not be expected to exceed PCD's historic water consumption levels or pumping capacity. Impacts to the water supply would be greatest during the operation of a baseline incineration facility (9,729,231 gal/yr). Modified incineration would require the next largest amount (7,876,000 gal/yr), followed by neutralization with biotreatment (5,700,000 gal/yr) or SCWO (1,300,000 gal/yr).

ES.4.3 ELECTRICAL POWER SUPPLY

PCD's electrical system would require improvements no matter which destruction option is selected. Electricity requirements for operating a neutralization facility with either SCWO (60 GWh/yr) or biotreatment (36 GWh/yr) would be higher than for incineration. Baseline incineration would require 29 GWh/yr while modified incineration would require 25.2 GWh/yr. However, the demand would be within the capacity limits of planned system upgrades.

ES.4.4 NATURAL GAS SUPPLY

Natural gas requirements of any of the destruction alternatives would be met by the current supplier; however, new pipelines would need to be installed from an existing on-post line to the project site. Baseline incineration would have the highest average requirements (391,500,000 ft^3/yr) because natural gas is the primary process fuel, and would be followed by modified incineration (200,000,000 ft^3/yr). Neutralization with SCWO and with biotreatment would require 149,000,000 ft^3/yr and 94,000,000 ft^3/yr, respectively.

ES.4.5 HAZARDOUS WASTES

Hazardous wastes from incineration would consist mainly of ash residue from the furnace system and brine liquids generated from the pollution abatement system. Hazardous solid waste would be transported off-site to a permitted waste disposal facility. The brine would be shipped to a commercial facility in accordance with applicable regulations for wastewater transportation, treatment, and discharge. Solid salts generated by the neutralization alternatives would also be transported to a permitted hazardous waste disposal facility.

ES.4.6 AIR QUALITY

Emissions from constructing and operating either an incineration or neutralization chemical munitions destruction facility are expected to be lower than National Ambient Air Quality Standards (NAAQS) and State Ambient Air Quality Standards (SAAQS). Although it can be argued that any level of emissions will have some impact, the standards are supported by research and developed conservatively by the regulatory agencies to ensure that they protect human health and the environment.

Impacts of facility construction would primarily involve fugitive dust from construction and earthmoving activities. Operation of an incineration facility would involve low emissions levels with no exceedances of standards expected. A neutralization facility would not involve use of an incinerator. However, neutralization would include stacks for process steam, boilers, diesel generators, and the SCWO or biotreatment areas. Any emissions would be below applicable standards.

ES.4.7 HUMAN HEALTH

Operational testing at JACADS provided the first full-scale information on emissions from incineration of chemical munitions. These data were used to conduct the first health risk assessment for agent incinerators. The assessment addressed only the inhalation pathway (USAEHA 1993). Since that time, three screening level human health risk assessment have been performed for the incineration facilities at Tooele, Utah, Umatilla, Oregon, and Pine Bluff, Arkansas (A. T. Kearny, Inc. 1966; Ecology and Environment 1996; and USACHPPM 1997). Additionally, as part of the licensing process, a RCRA part B Health Hazard Risk Assessment (HHRA) was completed for the Anniston, Alabama facility (U.S. Army 2001). These assessments show that the total cancer risk, the total chronic noncancer risk, and the total acute noncancer risk resulting from exposure to air emissions from incineration are all less than the Environmental Protection Agency (EPA)-established levels of concern for the general public. A site-specific health risk assessment will be conducted for PCD as part of the RCRA permitting process if incineration is selected.

Routine operations of a destruction facility and minor operational fluctuations (e.g., start-up and shut-down) might expose workers or the public to small (below standards) quantities of hazardous materials. A destruction facility implementing any of the four alternatives would be engineered to limit exposures to the greatest degree possible. Measures would include ventilation systems, pollution abatement systems, water recovery and recycling, remote handling of munitions, and personal protective equipment for workers.

ES.4.8 NOISE

Currently, the only on-post noise receptors are the residences located in the Administrative Area and Hi-Pardner Park, in the southern part of the depot. The off-post residence closest to the planned destruction facility location is about 0.5 mile north of the PCD boundary. At the nearest residence, the maximum outdoor noise level expected from facility operations may be slightly audible, and would not be expected to have any impact in terms of activity interference, annoyance, or hearing ability.

ES.4.9 VISUAL RESOURCES

PCD is located in a rural area where the surrounding landscape is primarily rolling, open pastureland used for livestock grazing. Despite this rural setting, the visual character of much of PCD is industrial. Thus, it is expected that the visual impacts of construction of a destruction facility using any of the four alternatives would not be significant.

ES.4.10 GEOLOGY AND SOILS

Impacts to soils of any of the four alternatives for destruction of the chemical munitions would be essentially the same. A total of approximately 85 acres of land could be disturbed for the facility and associated access roadways and utility corridors. This amount of land constitutes far less than 1% of the entire PCD installation. Topsoil would be removed and temporarily stockpiled for later use as the final backfill cover. The remaining disturbed soils would be distributed in adjacent areas and contoured to match the existing topography to the extent possible.

ES.4.11 GROUNDWATER

Baseline incineration would involve the highest process water requirements (29.9 acre-ft/yr), followed by modified incineration (24.2 acre-ft/yr), neutralization with biotreatment (17.5 acre-ft/yr), and neutralization with SCWO (4.0 acre-ft/yr), which would involve the least. A temporary, localized decline in the water table may accompany groundwater withdrawal. The incremental increase in water usage could also result in a slight increase in concentrations of any pollutants near their sources. However, these effects would be temporary, occurring only during facility operations, and would return to pre-operation conditions soon after operations are concluded.

ES.4.12 SURFACE WATER

During routine operations of a chemical munition destruction facility at PCD, no liquid effluents, hazardous or otherwise, would be released from either the destruction facility or support facilities into the surrounding environment. Sanitary waste resulting from operation of the facility would be treated and the effluent would be discharged to evaporation lagoons. There would be minimal impact to the surface water regime from destruction plant discharges during incident-free operation. Due to potential groundwater drawdown, a minor, temporary decrease in groundwater discharge to surface water is possible.

ES.4.13 TERRESTRIAL HABITATS AND WILDLIFE

Ecological resources at PCD are typical of and consistent with its upland location on a raised terrace above the Arkansas River. The PCD encompasses 23,000 acres. Impacts would be similar for all alternatives and would mainly result from clearing up to 85 acres for the agent destruction facility and utilities. Loss of a relatively small area of habitat, increased human activity in the G-Block area, increased traffic on local roads, and noise would be the most important factors that would affect wildlife species. Given the previously disturbed character of the area, the availability of similar habitat in the area, and the temporary nature of the proposed activity, the impacts would not be significant.

ES.4.14 AQUATIC HABITATS AND FISH

Because surface water bodies and wetlands are absent from the proposed construction site, direct and indirect adverse effects of construction of the baseline incineration alternative on aquatic ecosystems are unlikely. Previous screening level ecological risk assessments conducted for the agent incineration facilities at Tooele, Utah (A. T. Kearny, Inc. 1996), Umatilla, Oregon (Ecology and Environment 1996), and Anniston, Alabama (USACHPPM 1996) concluded that adverse effects of atmospheric pollutant deposition on nearby aquatic ecosystems was unlikely. Similarly, an environmental impact risk analysis for the Pine Bluff, Arkansas chemical munitions destruction facility concluded that emissions would not adversely affect aquatic organisms of nearby water bodies (USACHPPM 1997). Temporary alterations in the hydrologic regime and water quality of area surface waters as a result of groundwater usage by a destruction facility are a slight possibility. Because the effects would not be permanent, and the aquatic organisms are not believed to be unique for this region, the impacts would be expected to be negligible.

ES.4.15 PROTECTED SPECIES

No federally listed threatened or endangered species are known to occur at PCD. Suitable habitat exists for several threatened or endangered species that could occur in the surrounding area. No impacts to federally or state designated endangered, threatened, or candidate species would be expected from normal destruction facility operations. Should groundwater be found to contribute significantly to the water budget for certain surface waters and wetlands, groundwater usage could possibly adversely affect the population of Colorado-listed endangered southern red-bellied dace (also a federal sensitive species) which has become established in the AWS pond.

ES.4.16 WETLANDS

Wetlands at PCD are commonly associated with ponds, seeps, and streams. No wetlands occur on the proposed facility construction site. Should nearby wetlands be partially dependent on recharge from groundwater, they could experience slight temporary reductions in groundwater input with a consequent minor reduction in biotic carrying capacity, as an indirect result of groundwater withdrawal during operation of a destruction facility. Any such impacts should be quickly reversed upon completion of destruction operations.

ES.4.17 CULTURAL RESOURCES

On the basis of previous survey results and the high level of existing ground disturbance in the proposed project site, construction and operation of the chemical destruction facility is not likely to adversely affect eligible archaeological resources or historic structures.

ES.4.18 SOCIOECONOMICS

The impacts of constructing and operating a chemical munition destruction facility at PCD would be relatively small. The primary impacting factor for socioeconomics would be the direct employment associated with facility construction, operations and closure. This employment would result in direct income which would be spent in the local economy creating indirect employment and income.

ES.4.19 ENVIRONMENTAL JUSTICE

The number of minority and/or low-income sub-groups are larger near PCD than the average for the rest of Colorado. However, under normal operating conditions, the facility would be monitored continuously to ensure that any emissions remain below permitted levels and standards. Thus, there would be no adverse human health or environmental effects on any of the surrounding communities including those with minority and low income populations.

ES.4.20 ACCIDENTS

Measures would be employed during the operation of a chemical munitions destruction facility at PCD, whether incineration or neutralization technologies were employed, to reduce the potential for an accident. Additional measures would be in place to contain the contamination in the unlikely event that an accident involving agent should occur, and to clean up contaminated facilities and resources in the even more remote possibility that an accident should result in external contamination. In the extremely unlikely event that a large uncontrolled accident (i.e., a direct impact by an aircraft or major earthquake) were to occur during destruction facility operations using any of the four alternatives or continued storage of chemical munitions at PCD, significant environmental and health effects could occur. Under such a scenario, impacts would be essentially the same for any of the munitions destruction alternatives. Due to the larger inventory of chemical munitions in the storage igloos, the storage accident would provide the worst case scenario.

ES.4.21 MITIGATION

Mitigation measures include the following categories of safety enhancements (design, layout, and siting) for the destruction facilities under consideration; personnel reliability measures (hiring practices and training); monitoring of all destruction operations; personnel protection (procedures, clothing, and equipment); accident response planning, training, and resources; and emergency planning through the Chemical Stockpile Emergency Planning Program for the Pueblo area. As opportunities are identified, fine tuning measures will continue to be taken in each of these categories.

ES.4.22 CLOSURE AND DECOMMISSIONING

With passage of Public Law 99-145 in 1986, Congress directed the Army to destroy the U.S. Stockpile of chemical munitions, and mandated the dismantling and destruction of the demilitarization equipment and buildings upon completion of the stockpile destruction activities. Subsequent federal rule making (Public Law 106-79) and associated prescribed studies have raised the possibility that some chemical munitions destruction facilities may have other appropriate uses and have given the states involved the “right of first refusal”. That is, the Governors of the respective states have been granted the authority to make the initial decision, following completion of destruction operations, as to whether or not the facility should be used for other destruction operations. Based on current feasibility studies, the Army will recommend that the Pueblo stockpile destruction facility be used to destroy a small number (about one dozen) non-stockpile items stored there. The Army currently intends to close and dismantle the PCD facility upon completion of these destruction activities. Accomplishment of this mission will have positive impacts on all aspects of the surrounding environment and will facilitate implementation of the reuse plan that has been developed for PCD.

ES.5 REFERENCES

A.T. Kearny, Inc. 1996. *Tooele Chemical Demilitarization Facility, Tooele Army Depot South, EPA I.D. No. UT5210090002, Screening risk Assessment*, for State of Utah Department of Environmental Quality, Division of Solid and Hazardous Waste, Salt Lake City, Utah.

Ecology and Environment, Inc. 1996. *Draft Pre-Trial Burn Risk Assessment for the Proposed Umatilla Chemical Demilitarization Facility, Hermiston, Oregon*, Seattle, Wash., for Oregon Department of Environmental Quality, Bend, Oregon.

USACHPPM (U.S. Center for Health Promotion and Preventative Medicine) 1996. *Final Screening Level Risk Assessment: Anniston Chemical Agent Disposal Facility,* Risk Assessment No. 39-26-6683-97, prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Maryland.

USACHPPM (U.S. Center for Health Promotion and Preventative Medicine) 1997. *Environmental Impact Risk Assessment in Support of the NEPA Process for the Pine Bluff Chemical Agent Disposal Facility, Pine Bluff Arsenal, Arkansas,* Report No. 39-26-6683-97, prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Maryland.

USACHPPM (U.S. Center for Health Promotion and Preventative Medicine) 2001. *Resource Conservation and Recovery Act Part B, Risk Assessment for Anniston Chemical Agent Disposal Facility, Anniston Army Depot, Alabama*, Report No. 39-26-1299-99, prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Maryland.

USAEHA (U.S. Army Environmental Hygiene Agency) 1993. *Inhalation risk posed from incinerator Combustion Products, Operational Verification Testing – Phase 3, Johnston Atoll Chemical Agency Disposal System,* Health Risk Assessment No. 42-21-M1X6-93, U.S. Army Materiel Destruction Agency, Aberdeen Proving Ground, Maryland.

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

This Final Environmental Impact Statement (FEIS) has been prepared by the U.S. Army's Program Manager for Chemical Demilitarization (PMCD) to address the Army's proposal to construct, operate, and close a facility to destroy the stockpile of mustard-filled chemical munitions currently stored at the Pueblo Chemical Depot (PCD) near Pueblo, Colorado. This chapter

- introduces the Army's national destruction program,
- describes the purpose and need for the proposed destruction activities at PCD,
- discusses the scope of this FEIS and its approach to impact analyses,
- outlines the legal framework for the proposed destruction actions,
- explains the process for public involvement and participation, and
- discusses a separate DEIS addressing pilot testing one or more alternative chemical munition destruction technologies at one or more sites, including PCD.

The EIS addressing pilot testing for the non-incineration alternatives is being prepared by the Army's Assembled Chemical Weapons Assessment (ACWA) program. Its purpose is to assess the suitability of several United States (U.S.) storage depots, including PCD, for the construction and operation of one or more pilot facilities for testing non-incineration technologies for the destruction of assembled chemical munitions (i.e., those configured with agent and explosive components).

1.1 INTRODUCTION

Under a Congressional directive and an international treaty, the *Convention on the Prohibition of the Development, Stockpiling and Use of Chemical Weapons and Their Destruction*, called the Chemical Weapons Convention (CWC), the U.S. Department of the Army PMCD is currently destroying the nation's stockpile of lethal chemical agents and munitions, including both nerve and blister agents stored in the continental U.S. (CONUS). About 2,367 metric tons (2,610 tons) of chemical agent are stored in 780,078 munitions at PCD. Before destruction operations began at other installations, this quantity represented about 8.5% by agent weight of the total U.S. stockpile of lethal unitary chemical weapons.[1] All the chemical agents stored at PCD are of the blister type (HD and HT), also called mustard agent. For more detailed information, see the description of the chemical agents in Section 2.2.1.

[1]The term "unitary" refers to the use of a single, hazardous compound (i.e., chemical agent) in the munitions. In contrast, "binary" chemical weapons use two relatively nonhazardous compounds that are mixed together to form a hazardous or lethal compound after the munition is fired or released.

As shown in Fig. 1.1, PCD is one of eight CONUS Army installations where lethal agents and munitions are stored and where munition destruction is underway or proposed. The other Army installations are:

- Anniston Army Depot (ANAD), near Anniston, Alabama;
- Blue Grass Army Depot (BGAD), near Lexington, Kentucky;
- Deseret Chemical Depot (DCD), near Tooele, Utah;
- Aberdeen Proving Ground (APG), near Edgewood, Maryland;
- Newport Chemical Depot (NECD), near Newport, Indiana;
- Pine Bluff Arsenal (PBA), near Pine Bluff, Arkansas; and
- Umatilla Chemical Depot (UMCD), near Hermiston, Oregon.

The U.S. Congress directed the Army to accomplish the destruction of chemical agents and munitions in a manner that provides for (1) maximum protection of the environment, the general public, and personnel involved in the destruction process; (2) adequate and safe facilities designed solely for the destruction of the lethal chemical stockpile; and (3) cleanup, dismantling, and destruction of the facilities when the destruction program is complete.

Under Congressional directive, PMCD was established for decision making and oversight of the Chemical Stockpile Disposal Project (CSDP). In compliance with the National Environmental Policy Act (NEPA), a Final Programmatic Environmental Impact Statement (FPEIS) was completed for the CSDP in 1988. The Record of Decision (ROD) resulting from the FPEIS identified on-site incineration as the preferred method for destruction of the stockpile. Based on the findings of the ROD and substantial previous experience in munitions destruction at several facilities (see Appendix C), the Army initially selected high temperature incineration as the method for destroying chemical agents under the Congressional mandate. The National Research Council (NRC) has endorsed incineration as the method of choice for destroying the stockpile of chemical agents and munitions (NRC 1994, p. 130).

Following publication of the FPEIS, the Johnston Atoll Chemical Agent Disposal System (JACADS) facility was constructed and became operational in 1990. JACADS, the U.S. Army's first full-scale plant capable of destroying all types of munitions and agents, is located on Johnston Island in the central Pacific Ocean about 1,300 km (825 miles) southwest of Honolulu, Hawaii. The JACADS facility employs a disassembly and incineration process involving four incinerators (referred to as "baseline technology") as the best available method for meeting environmental and safety requirements. The JACADS munition disassembly equipment and incinerators were developed as a result of experience gained with destruction of munitions at Rocky Mountain Arsenal (RMA), Denver, Colorado, and with the Chemical Agent Munitions Disposal System (CAMDS) at Tooele, Utah. More recently, a second operational, full-scale, baseline facility at DCD began destroying chemical weapons in 1996.

Through November 2000, the Army has successfully destroyed over 6,205 metric tons (6,840 tons) of chemical warfare agents at the JACADS and Tooele facilities, including 263 metric tons (290 tons) of the same type of mustard agent stored at PCD. The JACADS facility completed destruction of 100% of the chemical agents stored on Johnston Atoll in November 2000, and is undergoing closure in compliance with the Resource Conservation Recovery Act (RCRA).

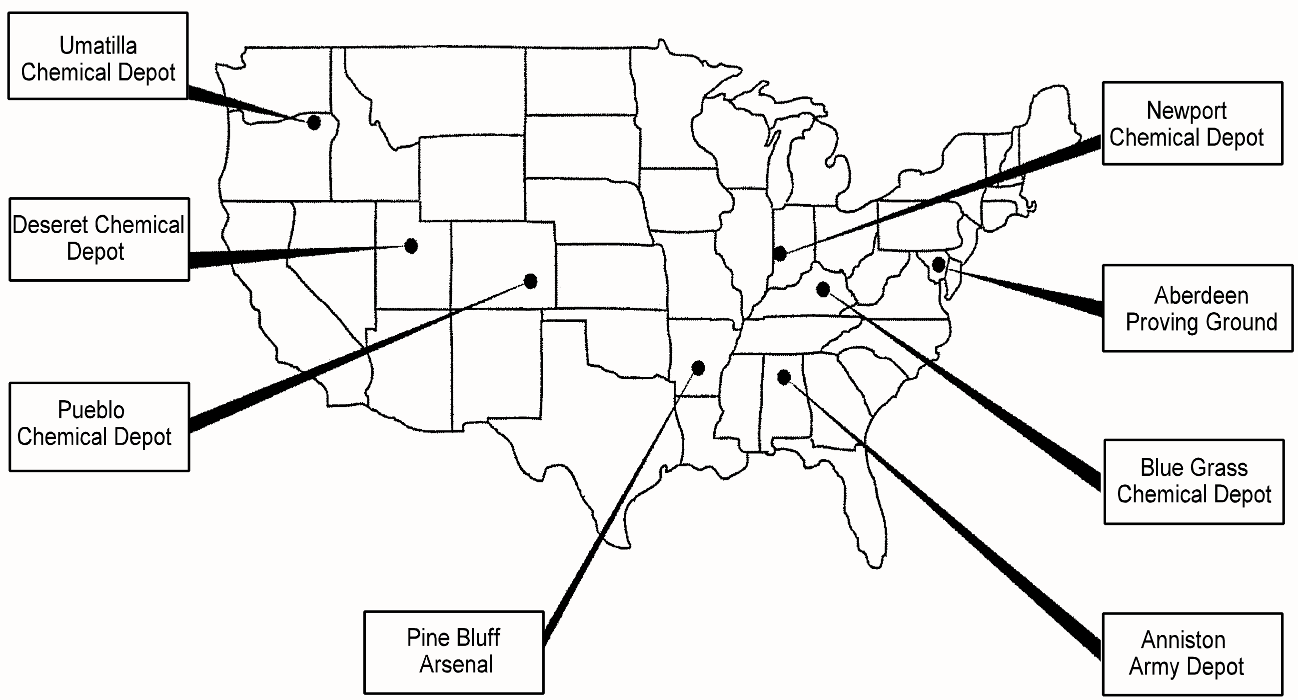


Figure 1.1. Locations of the U.S. Army's stockpile of lethal unitary chemical agents and munitions throughout the continental United States.

Destruction of the total stockpile of mustard agent on Johnston Atoll by JACADS has provided significant valuable experience and information concerning destruction of mustard-filled munitions. As a result, the Army has developed a modified incineration alternative for PCD based on the lessons learned. The stockpile at PCD consists totally of mustard filled munitions.

During this time, work has continued toward the development of other alternative technologies for destruction of chemical weapons. PMCD has facilities under construction to pilot test neutralization with SCWO at NECD and neutralization with biotreatment at APG. Additionally, with the establishment of the ACWA program for developing technological alternatives to incineration, the destruction technologies for the PCD inventory have been expanded to include the two chemical neutralization alternatives identified by ACWA (Sect. 1.5).

In January 1993, the CWC, an international treaty requiring destruction of chemical weapons, was signed by 65 nations. The CWC set the deadline for completing destruction of chemical weapons as 10 years after ratification of the treaty by the required number of nations and its subsequent entry into force. On April 24, 1997, the Senate of the U.S., one of the original signatory nations, ratified the CWC, which to date has been signed by over 130 nations. The necessary number of ratifications was obtained on October 31, 1996, with entry into force 180 days later; hence, the international deadline for destruction of chemical weapons is April 29, 2007. The U.S. law regarding stockpile destruction was revised to match the April 29, 2007, deadline date.

1.2 PURPOSE AND NEED

All the chemical agent or munition items currently in storage at PCD were manufactured prior to 1968. Some of them are in good condition, but others are in various stages of deterioration, and a few have developed leaks. Stockpile munitions are monitored through a regular inspection program. All leaking items have been either repaired on-site and decontaminated or placed in overpack containers and stored separately from non-leaking munitions.

The purpose of the proposed destruction activities at PCD is to (1) complete the destruction of the PCD inventory of chemical agents in compliance with U.S. Public Law 99-145 and the CWC and (2) conduct the destruction activities in a safe and environmentally sound manner. The need for the proposed action is to eliminate the risk to the public and to the environment from continued deterioration of the munitions in storage and to allow for the release of PCD land for reuse under the updated reuse development plan for PCD (PDADA 2000).

1.3 SCOPE

The Army has prepared this FEIS to assess the potential health and environmental impacts of the construction, operation and closure of a facility to destroy the chemical agent and munitions stored at PCD. The specific goal of the current analysis is to identify and compare the potential environmental impacts among the alternatives that could accomplish the destruction of the stockpile at PCD in compliance with the CWC. In addition, the risks and consequences of possible accidental releases of chemical agent are described and compared among alternatives, including no action. Four alternatives are addressed in this FEIS for possible use in destruction of the PCD stockpile: (1) the baseline incineration process currently in use by the Army at JACADS and DCD, (2) a modified incineration process, (3) chemical neutralization followed by supercritical water oxidation (SCWO), and (4) chemical neutralization followed by biotreatment. Any of these technology alternatives, or combination of alternatives, must be capable of destroying both the chemical agents and the munitions themselves, some of which contain explosive components. Descriptions of each of these alternatives are presented in Sect. 3.

As required by regulations of the President's Council on Environmental Quality (CEQ) (40 CFR 1500-1508), the no action alternative (i.e., not destroying the PCD stockpile) is also addressed, even though it is not a viable alternative because its implementation is precluded by Public Law 99-145. Additionally, the CSDP FPEIS clearly showed that continued storage poses greater risks than the proposed action at PCD.

The baseline incineration technology is a demonstrated destruction process. The lessons learned in destruction of mustard projectiles at JACADS have resulted in proposed modifications to portions of the baseline process which could be tailored to the Pueblo stockpile. Thus, the modified incineration process is not new technology. Rather, the key elements of the modified process have been successfully tested at JACADS. Agent trial burns would be conducted at PCD to demonstrate compliance to operational requirements and regulations prior to full-scale operations.

A key aspect of the modified incineration alternative is that frozen chemical agent would be fed into the incinerator while remaining inside the munition bodies, rather than being removed from the munition and fed separately into a liquid incinerator (LIC). This and other modifications allow for a reduction of the number of incinerators from four for baseline to one or two for modified incineration (Sect. 3), as well as significantly reduced potential for contamination.

As with the baseline facilities, trial burns would be conducted in the modified incineration facility before full-scale destruction operations could begin. Initial tests would be conducted without agent; trial burns would then be conducted with mustard agent. Results of these test burns would be submitted to the state of Colorado. If the test burn results were acceptable, the state of Colorado would impose final operating conditions as necessary, based largely on the requirements of RCRA and state regulations at 6 CCR 1001 and 1007-3. As long as operations continued, the Army would be subject to a variety of reporting, inspection, notification, and other permit requirements of the State of Colorado. RCRA also requires submittal of annual and biannual reports to the State of Colorado.

The information and analysis presented in this FEIS concerning the ACWA neutralization technologies is based on on-going studies, and has been provided by the ACWA Program. New information will continue to be evaluated as it becomes available. If neutralization followed by either SCWO or by biotreatment is selected for implementation at PCD, a pilot test facility would be constructed and operated prior to full-scale stockpile destruction operations. ACWA has provided estimated emissions rates and resource requirements for the two neutralization alternatives. Thus, estimated data concerning neutralization are available for comparison to actual emission rates for incineration. In order to bound the analysis of pilot testing the neutralization technologies, the ACWA information assumes 3-year operation. Operating the ACWA pilot test facility for 3 years would translate to complete destruction of the stockpile at PCD.

The results of the analyses presented in this Final Environmental Impact Statement (FEIS) show that any of the four chemical munitions destruction alternatives would be environmentally acceptable for destruction of the stockpile at Pueblo Chemical Depot. Neutralization with biodegradation is the agency's preferred alternative. The Army will continue to look for ways, to accelerate the process. Additional NEPA documentation will be completed as required. Following a 30-day comment period on this FEIS, the Department of the Army, on behalf of the Department of Defense, considering the results of this EIS along with other factors including cost, schedule, and public opinion, will publish the Record of Decision in the Federal Register.

1.4 PUBLIC INVOLVEMENT AND THE NEPA PROCESS

For the CSDP, the NEPA review process has been structured to address both programmatic and site-specific decision making. Programmatic-level decision making, which was completed in 1988, focused on alternative strategies, including destruction locations and the destruction technologies for destroying the stockpile. The programmatic decisions regarding on-site destruction versus off-site transport to another installation were national in scope and involved a number of separate but related issues and actions. Site-specific decision making is intended to focus on implementation of the programmatic strategy at a particular site and is not national in scope. This two-level NEPA approach was identified and acknowledged early in the NEPA process for the CSDP (A. A. Hill, Chairman, Council on Environmental Quality, Washington, D.C., letter to A. M. Hoeber, Deputy Under Secretary of the Army, Washington, D.C., June 2, 1986).

Implementation of this NEPA strategy for the CSDP began in January 1986 with the publication of a Notice of Intent (NOI) to prepare a Programmatic EIS. In July 1986, the Army issued a Draft Programmatic EIS for the CSDP. In response to comments on that Draft EIS and after numerous supporting studies were conducted during a 2-year period, an FPEIS was issued for the CSDP in January 1988 (U.S. Army 1988). The FPEIS identified on-site incineration as the environmentally preferred alternative. Subsequently, in the ROD for the FPEIS, the Army selected on-site incineration as its preferred alternative [*Federal Register* 53 (38), pp. 5816-17 (Feb. 26, 1988)]. Under Congressional directive, this FEIS — in concert with the ACWA DEIS — broadens the list of technologies under consideration to include pilot testing of chemical neutralization technologies.

The PMCD has supported the establishment and coordination of an Environmental Working Integrated Process Team (WIPT) to enhance communication among the U.S. Army, State of Colorado, local officials, and the public in the resolution of environmental issues, particularly related to permitting processes and NEPA. Specific steps are outlined below, which also provide opportunity for public involvement in the preparation of this FEIS. These steps are based on NEPA and its implementing regulations.

1.4.1 Notice of Intent

The first step in the preparation of a DEIS is the publication in the *Federal Register* of an NOI to prepare the DEIS. The publication of the NOI initiates the first opportunity for public involvement in the process. The NOI describes the proposed action, invites the public to participate in the scoping process for the DEIS, provides the location(s) and times for planned scoping meetings, and lists the name and address of the person to be contacted for further information. The NOI announces the known possible alternatives at the time the NOI is published. NEPA is a decision making tool, and as the process proceeds, alternatives may be added or eliminated depending on the information collected. New alternatives may also be identified through the public scoping process. NEPA requires Federal agencies to "rigorously explore and objectively evaluate all reasonable alternatives and, for alternatives which are eliminated from detailed study, briefly discuss the reasons for their having been eliminated" [40 CFR 1502.14(a)]. The NOI for this DEIS was published in the *Federal Register* on April 14, 2000. A copy of the NOI is provided in Appendix A.

1.4.2 Scoping Process

1.4.2.1 Mailing list

A project mailing list was developed early in the public participation process. The initial list included members of the general public and special interest groups who had expressed interest in prior environmental documents pertaining to the destruction of chemical weapons; federal, state, and local agencies and elected officials; minority, disadvantaged, and Native American groups; public libraries; and regional, state, and local media. This list has been maintained and updated throughout the process, and any additional individuals or organizations that express interest in the process will be added to it.

1.4.2.2 Public scoping process

Public scoping meetings have been held in those communities potentially impacted by the proposed action. These meetings were intended not only to inform the public about the proposed action but also to solicit public input concerning the issues to be addressed in the DEIS. The public scoping process assists the DEIS preparers in focusing on those significant environmental issues deserving of detailed study or analysis.

On May 9, 2000, the Army held two public scoping meetings for this DEIS as well as the related ACWA DEIS: one in Pueblo, Colorado, and the other at the PCD installation. The purpose of the meetings was to seek public input for identifying the significant issues related to the proposed action, which should be addressed in this FEIS. The scoping process involved public participation, including federal, State of Colorado, and local agencies, as well as residents within the potentially affected area. At the meetings, several prepared statements were presented by participants, and copies of these presentations were provided to the Army. Additionally, notes were taken by EIS preparers concerning individual comments, and forms were made available to participants for written comments. All of the comments received have been considered in the continuation of the EIS process.

1.4.2.3 Scoping results and key issues

Input received during the scoping process for the PMCD DEIS for construction, and operation and closure of a facility to destroy the assembled chemical munitions stored at PCD is summarized in the following list. These issues were taken into consideration in developing the scope of this FEIS.

- consideration of the full range of available technologies, including the presentation of reliable, comprehensive data for all viable technologies;
- the rationale for the concurrent preparation of two EISs that include PCD by two Army programs, PMCD and ACWA, including clear definition of the purposes and scopes of the two EISs;
- releases and by-products associated with the various technologies for destroying the stockpile at PCD; potential effects of these substances on human health and development at all life stages, including those with infirmities; validity of the use of dilution factors for emissions and the effects of exposure to chronic low-levels, including below standard levels; effects of dioxins, polychlorinated biphenyls, and other persistent organics; emissions of greenhouse gasses; and noise levels;
- potential impacts to surface water, wetlands, and floodplains; potential for contamination and/or depletion of groundwater resources;
- risks, and the costs and benefits associated with the technology alternatives;
- the potential cumulative and direct impacts to plants, animals, and ecosystems; bioaccumulation of products of incomplete combustion;
- potential for impacts on agriculture and agricultural products;
- demands of the alternatives on available resources including water use, water rights, natural gas, and electricity;
- storage and disposal of waste products;
- post operations plans including the fate of the facility constructed (whether full-scale destruction or pilot plant) after completion of destruction operations at PCD;
- relationship and interaction of the proposed action with base realignment, closure, and reuse plans;
- socioeconomic impacts to the surrounding area, including land use, housing, and economic health; environmental justice considerations; cultural and archaeological resources;
- current procedures for monitoring stored munitions; monitoring and inspection during destruction operations;
- need for road construction; increased traffic;
- compliance of the proposed action with applicable laws and regulations;
- adequacy of installation emergency planning capabilities; and
- consideration of operational experience with incineration: estimates based on worst-case assumptions.

1.4.3 Notice of Availability for DEIS

Following the scoping process, the DEIS is prepared, copies are circulated to other government agencies and to interested members of the public, and a notice of availability (NOA) of the DEIS for public comment is published in the *Federal Regist*er. Public meetings are held to receive comments of stakeholders and interested parties concerning the DEIS, and a minimum of 45 days must be allowed for the public to comment on DEIS.

The NOA for the DEIS was published in the Federal Register on May 11, 2001, and copies of the DEIS were made available for public review. A 45-day comment period started with the publication of the NOA. Public meetings were held at Pueblo on June 6, and at Avondale on June 7, 2001. Because both the PMCD and ACWA DEISs were being reviewed simultaneously, the review period was extended by an additional 45 days, ending on August 9, 2001 (see Appendix K).

1.4.4 Notice of Availability for FEIS

All comments received on the DEIS are displayed, considered, and addressed in the Final EIS (FEIS). Upon completion of the FEIS, a NOA will be published in the *Federal Register*. A minimum of 30 days must be allowed for final public comment on the FEIS prior to publication of the ROD.

1.4.5 Record of Decision

After full public review of the FEIS, the concluding step in the NEPA process is the preparation and publication of a ROD for the proposed action. The ROD will identify all alternatives considered by the U.S. Army in reaching its decision, specifying the alternative or alternatives which were considered to be environmentally preferable. The U.S. Army may discuss differences among alternatives based on other relevant factors, including economic and technical considerations and statutory missions. The U.S. Army may also identify and discuss other factors, including any essential considerations of national policy (e.g., CWC), which were balanced in making its decision and state how those considerations entered into the final decision.

1.4.6 Defense Acquisition Board Decision Process

A decision on which of the alternatives will be implemented in carrying out the proposed action (destruction of the chemical munitions stored at PCD) will be made by the Defense Acquisition Board (DAB) through a process that will consider a wide range of factors and will incorporate the review and input of diverse organizations as well as the public. The factors include, but are not limited to, environmental considerations (including the impacts of alternatives assessed through the NEPA process), laws and regulations, mission needs (at PCD as well as from a national perspective), implications for compliance with the CWC, budget considerations, schedule, public concerns, and political concerns.

The process that has been established to select the technology to be used to destroy the chemical weapons stored at PCD is displayed in Fig. 1.2. As indicated in that figure, various integrated process teams established within the Department of Defense as part of the DAB Review of the Chemical Demilitarization Program will review information and analyses and develop further analyses and recommendations that will be forwarded up the line to the ultimate decision-maker. These integrated process teams include: (a) three Working Integrated Process Teams (WIPTs) co-chaired by PMCD and PMACWA representatives, one each for cost and schedule, programmatic and acquisition, and safety and environmental factors, (b) an

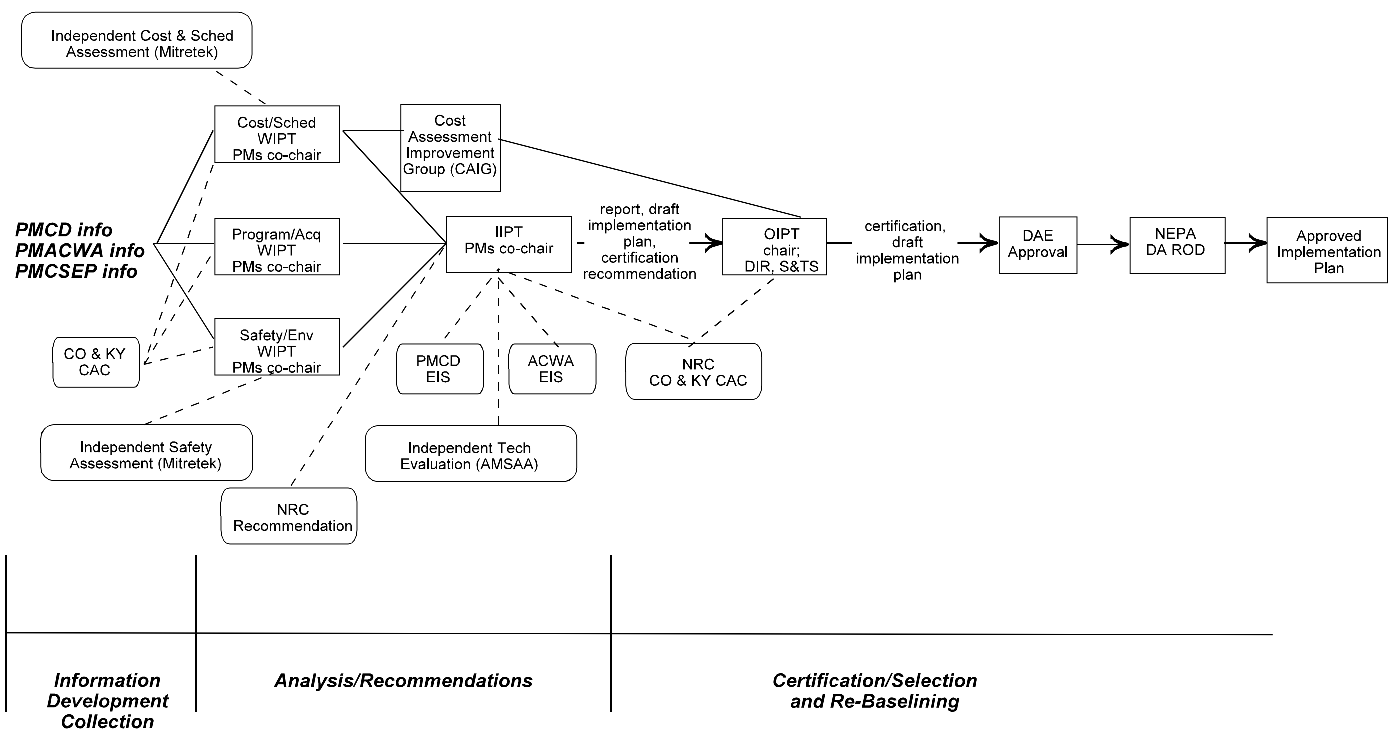


Figure 1.2. Defense Acquisition Executive (DAE) review process for selecting the technology for destroying the PCD chemical weapons stockpile.

Integrating Integrated Process Team (IIPT) co-chaired by PMCD and PMACWA representatives, and (c) an Over-Arching Integrated Process Team (OIPT) chaired by the Director of Science and Technology for the Department of Defense.

In addition to the analyses, results, and conclusions provided in this EIS and the ACWA EIS, these teams will review analyses, results, and conclusions identified in an independent cost and schedule assessment (being prepared by Mitretek), an independent safety assessment (being prepared by Mitretek), an independent technology evaluation (being prepared by the Army Materiel Systems Analysis Activity (AMSAA), an analysis by the Department of Defense's Cost Assessment Improvement Group (CAIG), and reviews prepared by the National Research Council (NRC). The integrated process teams will also consider input provided by the public through the Colorado Citizens Advisory Commission (CAC). The OIPT will certify the viability of technology for PCD and present its recommendations to the DAB for its consideration. The ROD for the technology to be implemented to destroy the chemical weapons stockpile at PCD will be made by the DAB. If a non-incineration technology is selected for PCD, Public Law 105-261 requires it to be certified. Independent analysis will need to be made then to certify that the technologies are as safe, cost effective, and timely as incineration.

1.5 RELATION OF THIS FEIS TO ACWA ACTIONS

In September 1996, the NRC’s committee on Alternative Chemical Disposal Technologies, which evaluated alternatives to incineration, issued a set of findings (NRC 1996). The Army evaluated the NRC’s recommendations and, with approval from the Department of Defense (DOD), decided to proceed with pilot-scale testing of two alternative technologies at sites which store bulk agent in non-explosive configurations. PMCD currently has under construction a full-scale pilot facility to test chemical neutralization of the nerve agent VX with SCWO at NECD (U.S. Army 1998a), and a full-scale pilot facility to test chemical neutralization of mustard agent with biotreatment at APG (U.S. Army 1998b).

Additionally, in 1996, Congress enacted Public Law 104-201, which directed DOD to conduct an assessment of the CSDP for destruction of assembled chemical munitions and of the alternative destruction technologies and processes (other than incineration) that could be used for the destruction of the lethal chemical agents that are associated with these munitions. The law required that the assessment be conducted by a program manager not associated with the PMCD. Through the follow-up Public Law 104-208, the new ACWA program was required to identify and demonstrate no fewer than two alternatives to the baseline incineration process for the destruction of assembled chemical munitions. This law also prohibited any obligation of funds for the construction of incineration facilities at PCD, as well as BGAD, until the demonstrations had been completed and an assessment of the results had been submitted to Congress. (NRC 1999)

As a result of Public Laws 104-201 and 104-208, DOD created the ACWA program. The Program Manager for ACWA established the following three-phase program to bring at least two technologies to the demonstration stage as mandated by Congress:

- *Phase 1.* Develop evaluation criteria for assessing alternative technologies and issue a request for proposals (RFP) from industry of technologies for destroying assembled chemical weapons without using incineration.

- *Phase 2.* Assess the proposed technologies and select the most promising for demonstration.
- *Phase 3*. Demonstrate whether the selected technologies could destroy assembled chemical munitions.

In August 1997, after detailed evaluation criteria had been developed with input from stakeholders, the Program Manager for ACWA issued an RFP calling for a total system solution for the destruction of assembled chemical weapons. Twelve proposals were submitted in response to the RFP, and seven were selected for possible demonstration. Because Public Law 104-201 required that DOD conduct the technology assessment in coordination with the NRC, the Program Manager for ACWA asked NRC to perform an independent technical review and evaluation of the seven technology packages that had passed DOD's initial screening criteria. DOD used the NRC review as one factor in determining whether to recommend further development and implementation of any of the technology packages in its report to Congress on September 30, 1999 (NRC 1999). Three technologies were selected from the list of seven:

- Burns and Roe plasma arc technology,
- General Atomics neutralization followed by SCWO, and
- Parsons-Honeywell neutralization followed by biotreatment process.

The Burns and Roe plasma arc technology package was subsequently eliminated because of the lack of testing of the technology with actual chemical agent or propellant, the presence of significant unresolved engineering problems with the technology, and the concern that scale-up from the small units in existence to the very large units proposed would likely present significant scientific and engineering challenges (NRC 1999). The process just described resulted in the selection of neutralization with SCWO and neutralization with biotreatment as the neutralization technologies to be considered for pilot testing at PCD, which stores only mustard filled munitions. Subsequent ACWA investigations resulted in the selection of two additional neutralization technologies to be considered for pilot testing at ANAD, BGAD, and PBA, which store both mustard and nerve agent filled munitions.

An ACWA DEIS was prepared for follow-on pilot testing of successful ACWA program demonstration tests at PCD and the three other locations pursuant to the process established by Congress in Public Laws 104-208 and 105-261. That DEIS addressed a related purpose: to determine which ACWA technologies can be pilot tested, and at which site or sites. The ACWA DEIS is distinct from this PMCD FEIS for PCD in that its emphasis is on the feasibility of pilot testing one or more of the demonstrated and approved ACWA neutralization technologies, considering the unique characteristics of the four alternative installations, including PCD. The ACWA DEIS does not specifically address the use of a full-scale facility to accomplish destruction of the inventory stored at PCD. However, information provided by the ACWA program concerning the neutralization alternatives provides the basis for analysis of the neutralization technologies and comparison with the incineration technologies in this site-specific FEIS for stockpile destruction at PCD.

This PMCD FEIS and the ACWA DEIS serve complementary but distinct purposes. This PMCD FEIS continues the process that began when Congress established the PMCD in 1985. Current law requires the destruction of the chemical weapons stockpile by the CWC deadline of April 2007. This requirement still exists, notwithstanding the establishment or success of the ACWA program.

1.6 APPROACH TO IMPACT ANALYSIS

This NEPA analysis has been conducted to comply with U.S. Public Law, international treaty (the CWC), to protect public health by destruction of aging chemical munitions, and to support the release of PCD land for reuse and development.

This FEIS identifies, documents, and evaluates the potential effects of construction, operation, and closure of a facility for destruction of the inventory of mustard-filled munitions currently stored at PCD. An interdisciplinary team of engineers, health and environmental scientists, air quality and water quality specialists, socioeconomic and cultural resource specialists, and planners performed the impact analyses. The team has identified resources and topical areas, incorporated information and comments from the scoping process, analyzed the proposed action against the existing conditions, and determined the relevant beneficial and adverse effects associated with the proposed action.

Section 4 of this FEIS generally describes the existing conditions of the potentially affected resources and other areas of special interest on and in the vicinity of PCD. The region of potential impact (ROI) consists primarily of Pueblo County, Colorado, in which the PCD is located. These conditions constitute the basis for the assessment of potential effects of stockpile destruction at PCD. The potential effects of the proposed action are also described in Sect. 4. Mitigation measures that could reduce either the likelihood or severity of adverse impacts are identified where appropriate.

This FEIS analyzes direct impacts (i.e., those caused by or directly associated with implementation of the proposed action and occurring at the same time and place) and indirect impacts (i.e., those caused by implementation of the proposed action and occurring later in time or farther removed in distance but still reasonably foreseeable). Examples of indirect effects include induced changes in the pattern of land use, population growth rates, and related effects on air and water and/or other natural systems, including ecosystems.

Cumulative effects (i.e., those resulting from the incremental impacts of the proposed action when added to other past, present, and future actions regardless of what agency, organization, or person undertakes such other actions) are also addressed. Cumulative effects include those that might result from individually minor, but collectively significant, actions taken over a period of time.

1.7 LEGAL FRAMEWORK FOR THIS ANALYSIS

Chemical agent destruction is being carried out in compliance with both a Congressional mandate and the CWC. The mandate was originally expressed in Title 14, Part B, Sect. 1412 of Public Law 99-145, the *Department of Defense Authorization Act* of 1986. Public Law 99-145 established the CSDP and directed that the destruction of the agents and munitions be accomplished by September 30, 1994. Amendments contained in subsequent Public Laws 100-456, 102-190, and 102-484 extended the deadline, the latter to December 31, 2004. Ratification of the CWC moved the deadline to April 29, 2007.

A federal undertaking, such as the CSDP, must also conform to the provisions of NEPA (Public Law 91-190, as amended by Public Laws 94-52 and 94-83). The procedural aspects of NEPA are implemented by regulations (40 CFR Parts 1500-1508) which were developed by the CEQ. As detailed in those regulations, a NEPA review is conducted to ensure that environmental factors are given adequate consideration early in the decision-making process. The NEPA process provides federal agencies with a firm basis for weighing the significance of the environmental impacts of a proposed action against those of alternatives prior to a decision on implementing any action.

This FEIS has been prepared in fulfillment of the CEQ regulations implementing NEPA. In addition, this document follows Army Regulation (AR)-200-2, which contains policy and procedures for implementing both NEPA and CEQ regulations within the U.S. Army system.

A decision on which of the alternatives will be implemented in carrying out the proposed action (destruction of the PCD chemical munitions stockpile) rests on numerous factors, such as PCD's mission requirements, schedule, availability of funding, and environmental considerations. In addressing environmental considerations, PCD is guided by several relevant statues (and implementing regulations) and Executive orders that establish standards and provide guidance on environmental and natural resources management and planning. These include, but are not limited to, the following;

- Clean Air Act,
- Clean Water Act,
- Noise Control Act,
- Endangered Species Act,
- Farmland Protection Policy Act,
- National Historic Preservation Act,
- Archaeological Resources Act,
- Resource Conservation and Recovery Act,
- Certificate of Designation (Pueblo Board of County Commissioners)
- Toxic Substances Control Act,
- Executive order 11988 *(Floodplain Management)*,
- Executive Order 11990 (*Protection of Wetlands*),
- Executive Order 12088 (*Federal Compliance with Pollution Control Standards*),
- Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*), and
- Executive order 13045 (*Protection of Children from Environmental Health Risks and Safety Risks*).

Where useful to better understanding, key provisions of these statutes and Executive Orders are described in more detail in the text of the FEIS.

While NEPA documents often include discussions of technology-related and regulatory issues, they are required to be prepared early in the planning process and, therefore, rarely contain design information sufficiently detailed for the various permits required by other statutes. Regulatory compliance for the CSDP will require the Army to submit a comprehensive, detailed description of the destruction technology selected, as well as the proposed pollution control measures along with the applications for permits to be issued pursuant to RCRA, the Clean Air Act, the Federal Water Pollution Control Act, and other applicable laws, regulations, and executive orders. Thus, separate regulatory documentation beyond the scope of this FEIS will be prepared, as necessary, independent of the NEPA review process for PCD. The permitting process may also include public meetings to discuss pertinent environmental issues. In particular, the permitting process for RCRA will address issues that are related to the selected destruction technology; it will also provide an additional forum for public comment.

1.8 CITIZENS' GROUPS

1.8.1 Citizen's Advisory Commissions

The establishment of Citizens' Advisory Commissions was authorized in the 1993 Defense Authorization Act (Public Law 102-484). According to the law, the Secretary of the Army must establish a Chemical Demilitarization Citizens' Advisory Commission for each state with a low-volume chemical stockpile site (NECD, BGAD, and APG). The Secretary of the Army was also empowered to establish commissions for other stockpile states, if requested by the governors of those states.

The Department of the Army provides a representative to meet with each commission to hear citizen and state concerns regarding the CSDP. Each commission is composed of nine members appointed by the governor. Seven of these individuals must be from areas within a 805-km (500-mile) radius of the stockpile location, and the other two members must be from a state agency with direct responsibilities related to the program.

Each commission has a designated chairman and consists of unpaid volunteers. The commissions meet with the Army representative at least twice a year and will disband after the chemical weapons stockpiles in their respective states are destroyed. The governor of Colorado has established a Citizens' Advisory Commission for PCD.

1.8.2 Dialogue

To ensure public involvement in the ACWA program, DOD enlisted the Keystone Center, a nonprofit, facilitation organization, to convene a diverse group of interested stakeholders, called the Dialogue on ACWA (or simply the Dialogue). The 35 members of the Dialogue include representatives of the affected communities, national citizen groups, state regulators, tribal representatives, the EPA, and the DOD staff, including the program manager for ACWA, his deputy, and the deputy assistant to the Secretary of the Army for Chemical Demilitarization. All non-DOD members of the Dialogue are volunteers and receive no remuneration from DOD (except for travel expenses). Ground rules were developed for the involvement of the Dialogue, which meets regularly and participates in all phases of the assessment (NRC 1999). All decisions remain the responsibility of DOD.

In response to a request from the Dialogue for independent advice on technical issues throughout the program, the program manager for ACWA agreed to fund a consulting firm, SBR Technologies from South Bend, Indiana, to meet with a four-member liaison team. Together with representatives of SBR Technologies, these four Dialogue members formed the Citizen's Advisory Technical Team (CATT) to represent the Dialogue in procurement-sensitive matters. Once the members of CATT had signed nondisclosure agreements with all technology providers, they were given access to all proprietary information, and they participated as nonvoting members in DOD's procurement, evaluation, and selection processes.

1.9 REFERENCES

NRC (National Research Council) 1994. *Recommendations for the Disposal of Chemical Munitions and Agents*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1996. *Review and Evaluation of Alternative Chemical Disposal Technologies*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1999. *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*, National Academy Press, Washington, D.C.

PDADA (Pueblo Depot Activity Development Authority) 2000. *Pueblo Chemical Depot Reuse Development Plan Update*, June.

U.S. Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1 to 3, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

U.S. Army 1998a. *Final Environmental Impact Statement for Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., December.

U.S. Army 1998b. *Final Environmental Impact Statement for Pilot Testing of Neutralization/Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., July.

2. THE PROPOSED ACTION

The proposed action is the construction, operation, and closure of a facility to destroy the mustard-filled chemical munitions stockpile currently stored at PCD. This section describes the depot, the chemical munitions stockpile, the generic elements of the destruction process, the handling and transportation processes required, and the proposed reconfiguration of munitions prior to destruction. A detailed discussion of the alternative technologies for completing the destruction of the chemical munitions stored at PCD is presented in Sect. 3 and Appendix D of this EIS.

2.1 PUEBLO CHEMICAL DEPOT

PCD is located in Pueblo County, Colorado, about 160 km (100 miles) southeast of Denver and 23 km (14 miles) east of the center of Pueblo (see Fig. 2.1); the Arkansas River is about 1.6 km (1 mile) south of PCD. The depot encompasses approximately 9,300 ha (23,000 acres) and is situated on flat to gently sloping prairie. Surrounding land areas are mostly undeveloped ranchland used for grazing and agriculture, with some light commercial and residential zoning to the south. A Transportation Technology Center (TTC), operated by the U.S. Department of Transportation, is located to the north.

PCD was established by the U.S. Army in 1942 as the Pueblo Ordnance Depot for storage and supply of ammunition and general supplies during World War II. After the war, PCD became responsible for rebuilding and maintaining artillery fire control and optical materials and for reconditioning transport and combat vehicles. Responsibility for the distribution and storage of ammunition for a six-state area and various supplies for a nine-state area was added by 1951.

By the early 1970s, PCD had become a special weapons center, with responsibility for distribution and training and for accountability of general supply stocks at three other reserve depots, rebuilding and maintaining guided missiles and radio-controlled aerial targets, distributing U.S. Air Force ammunition over an eight-state area, storing strategic and critical materials, and calibrating and maintaining electronic test equipment. In 1974, PCD was reduced to activity status and was assigned to the Tooele Army Depot, Utah. Activities, personnel, and missions were reduced.

Through Public Law 100-526, the *Defense Authorization Amendments and Base Closure and Realignment Act*, Congress directed the Secretary of Defense to close or realign all military installations recommended for such action by the Defense Secretary's Commission on Base Realignment and Closure. The Commission was chartered on May 3, 1988 to recommend military installations within the United States and its commonwealths, territories, and possessions for realignment and closure. PCD was recommended for realignment by the Commission in December 1988. The primary activities involved in the PCD realignment were the transfer of the supply mission to various locations, the transfer of the conventional ammunition mission to McAlester Army Ammunition Plant, and the elimination of conventional ammunition at PCD. The potential impacts of these actions have been analyzed in a separate

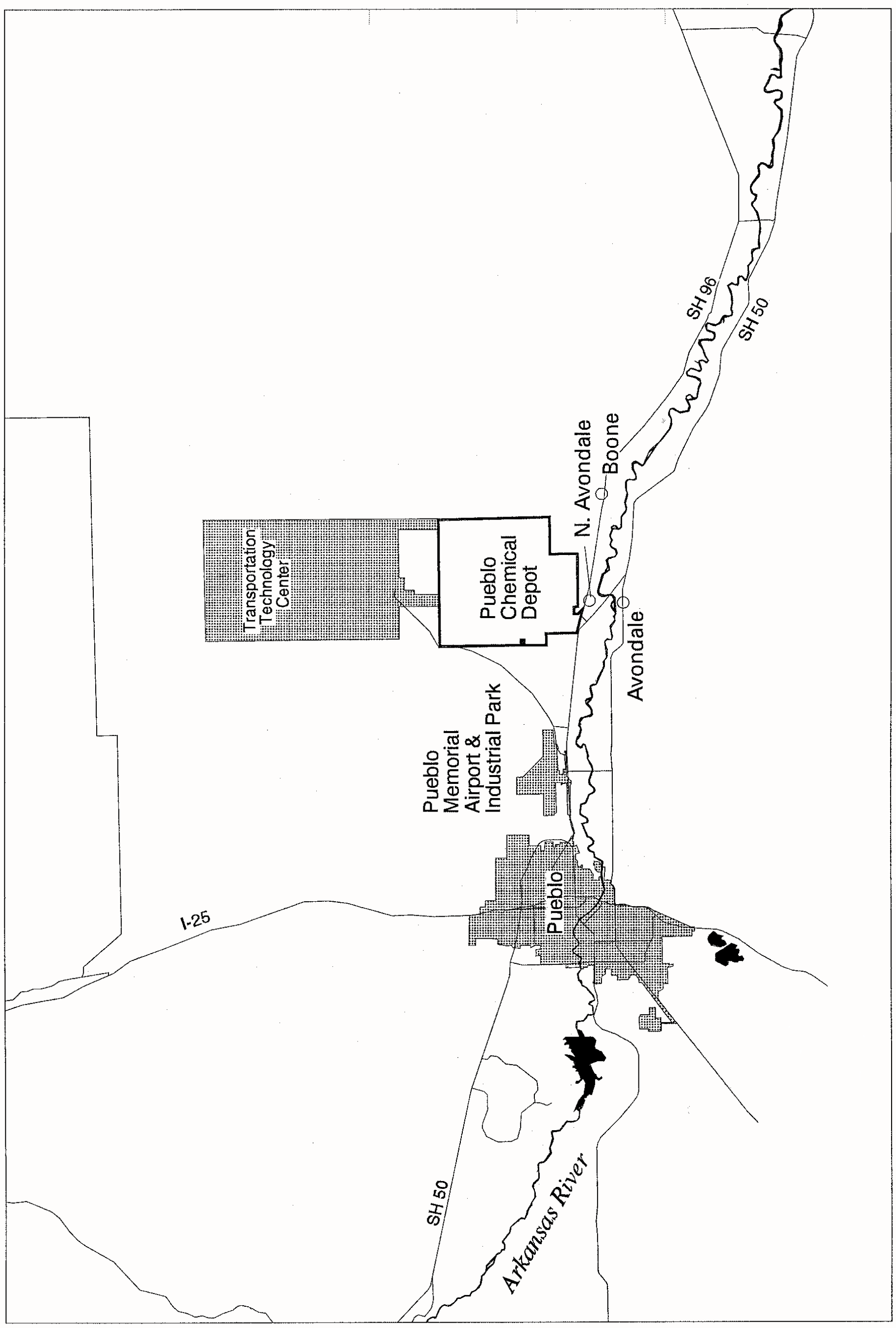


Figure 2.1. Regional location of the Pueblo Chemical Depot (PCD) in Colorado.

EIS (U.S. Army 1991) and are not addressed in this site-specific FEIS, other than as part of the cumulative impacts.

The current missions at PCD, now under the Soldier Biological and Chemical Command, are to provide limited maintenance to prevent deterioration of active facilities, to manage the chemical munitions stockpile on-site, and to prepare for chemical munitions destruction under the CSDP. PCD does not manufacture, use, or test munitions. Tenants at the installation include the Occupational Health Clinic (from Fort Carson), the 597th Engineering Group of the Colorado National Guard, and several organizations with leases through the Pueblo Depot Activity Development Authority.

The facilities at PCD include about 270 buildings used for general administration, housing, maintenance, and storage, and 912 earth-covered concrete igloos for storage of conventional (810) and chemical (102) munitions. Of the 102 igloos in the chemical munitions storage area, 95 contain chemical munitions. PCD also contains active and inactive demolition grounds and undeveloped perimeter zones.

2.2 STOCKPILE DESCRIPTION

2.2.1 Chemical Agents

The lethal chemical agents stored at PCD are vesicant or "blister" agents. Table 2.1 summarizes some of the physical and chemical characteristics of these agents. The vesicant or blister agents stored at PCD are the mustard-derived agents HD and HT. The major toxic

Table 2.1. Characteristics of chemical agents stored at the Pueblo Chemical Depot

	Agent HD	Agent HT
Common name	Distilled mustard	Thickened mustard
CAS[a] number	505-60-2	N/A (mixture)
Chemical name	bis(2-chloroethyl)sulfide	approx. 60% HD an 40% T[b]
Chemical formula	$C_4H_8Cl_2S$	N/A (mixture)
Vapor pressure [at 77°F (25°C)]	0.11 mm Hg	0.104 mm Hg
Liquid density [at 77°F (25°C)]	1.27 g/cm^3	1.27 g/cm^3
Freezing point	57°F (14°C)	33°F (1°C)
Color	Amber to dark brown	Amber to dark brown
Mode of action	Blistering of exposed tissue	Blistering of exposed tissue

[a]Chemical Abstracts Service.
[b]Agent T is bis[2(2-chloroethylthio)ethyl] ether; CAS No. 63918-89-8.

chemical [bis(2-chloroethyl)sulfide] in HD is also known as mustard gas (actually a liquid), sulfur mustard, or mustard. HD is the purified form of mustard agent from which the impurities have been removed by washing and distillation. HT is an approximate 60:40% blend of agents HD and T {bis[2(2-chloroethylthio)ethyl] ether}. The addition of T to HD creates a form of mustard agent which has a longer duration of effectiveness and a lower freezing point than HD.

The principal health effect of vesicant exposure is blistering of exposed tissues, potentially causing severe skin blisters, injuries to the eyes, and damage to the respiratory tract by inhalation of vapors. Because of its chemical properties, mustard agent can react with a variety of tissue constituents including nucleic acids, the genetic material of the cell. Biological evidence indicates that mustard exposure can result in carcinogenesis. Considering inhalation toxicity, HT is more toxic than HD due to the considerable biological activity contributed by agent T (U.S. Army 1988, Appendix B).

Mustard is extremely persistent when isolated from sun, wind, and rain; it can still be found in European trench areas sealed during World War I. However, mustard hydrolyzes and degrades in the open over a period of several days; temperature is a major factor in natural deterioration. The mustard agents are hazardous to humans and to animals. The type and extent of the hazard depend on the physical and toxicological characteristics of the agent and the extent, route, and duration of the exposure. This FEIS considers health effects resulting from inhalation only, since this would be the principal mechanism of exposure during routine handling and destruction activities. A detailed explanation of the human health effects of exposure to these agents is given in the FPEIS (see Appendix B in U.S. Army 1988); information on the effects on animals can also be found in the FPEIS (see Appendix O in U.S. Army 1988).

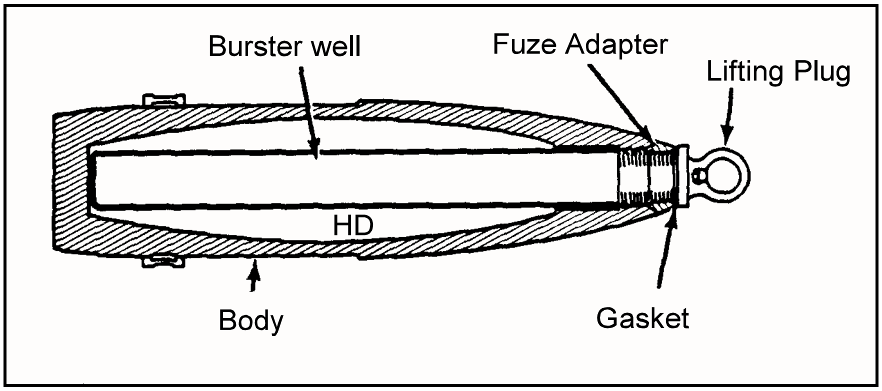
2.2.2 Chemical Munitions

The chemical stockpile at PCD consists of 780,078 chemical munitions. Initially, this comprised 8.5% by agent weight of the total U.S. chemical stockpile. This percentage has changed as JACADS and DCD have destroyed a portion of the stockpile. The PCD inventory includes the two mustard agents (HD and HT) contained in three munition types (155-mm and 105-mm projectiles, and 4.2-in. mortar rounds). Figure 2.2 shows schematic illustrations of each munition type.

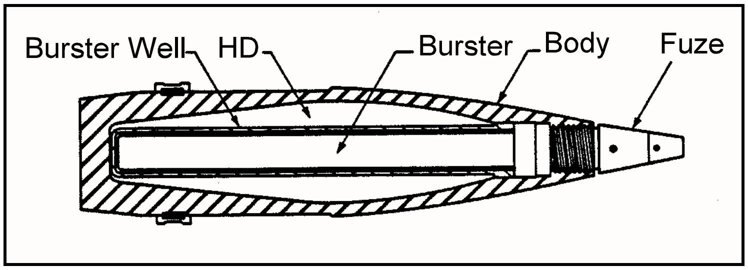
The chemical weapons (munitions) to be destroyed at PCD all consist of a metal casing containing the chemical agent mustard. These munitions also contain an explosive and a burster, for chemical agent dispersal. The burster may be accompanied by a fuze, an initiating mechanism, and an additional supplemental charge (SciTech 1998).

The explosives used to disperse the mustard agent include tetryl, tetrytol, Composition A5, Composition B4, and trinitrotoluene (TNT). Composition A5 is the explosive RDX mixed with stearic acid. Composition B4 is a mixture of TNT and RDX (CBDCOM 1997). Tetrytol is a mixture of tetryl and TNT. These explosives are also used in non–chemical munitions. Although these explosives are powerful, they are relatively insensitive to heat or shock.

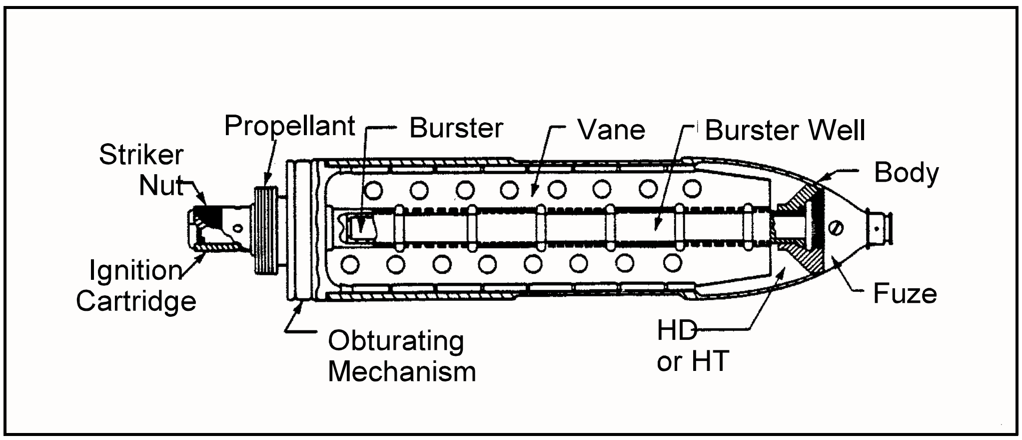
A fuze assembly containing a more sensitive explosive compound, such as lead azide, must be used to detonate the explosives listed above. Fuzes are mechanical devices that include a variety of safety mechanisms to protect the explosives from accidental detonation.



155-mm artillery projectile



105-mm artillery projectile



4.2-in mortar projectile

Figure 2.2 Schematic illustration of the types of chemical munitions stored at the Pueblo Chemical Depot: (a) 105-mm projectiles, (b) 155-mm projectiles, and (c) 4.2-in. mortar projectiles.

The munitions in the stockpile at PCD were designed to function with a propellant which fired or launched the weapon. The propellants are designed to generate large quantities of gaseous products through rapid burning. The propellants used in munitions at PCD are composed of nitrocellulose and nitroglycerin in varying proportions. Other chemicals are added to this mix to control the rate of burning and other attributes of the propellants. The propellants are relatively insensitive to shock and heat. Together, explosives and propellants comprise a category of materials referred to as energetics.

Any single munition contains mustard agent and one or more types of energetic (some munitions may have one or more of their component energetics removed and stored separately). There are three munition configurations:

- *Mortar*: A projectile designed to be fired from a muzzle–loaded cannon. PCD mortar projectiles are assembled with fuzes and propellants in addition to the agent and dispersing explosives.
- *Projectile*: A weapon designed to be fired from a cannon, but without propellants attached. Chemical weapons stockpile projectiles contain dispersing explosives. The projectiles stored at PCD are designed for breech–loading. That is, for artillery with the load, lock, and fire mechanism at the rear of the barrel or firing tube.
- *Cartridges*: A projectile assembled with a fuze and packaged with propellants in addition to the agent and dispersing explosives.

2.2.3 Storage Configurations

All chemical agents and munitions at PCD are maintained within a chemical storage area at which extensive security precautions are taken to control entry and egress. All the munitions in the PCD inventory are stored inside concrete earth-covered structures (commonly called igloos) in the north-central portion of the installation.

The storage igloos are designed to protect the munitions from blast and shrapnel if a neighboring igloo were to detonate. The igloos are constructed of reinforced concrete and have steel or concrete/steel doors. A lightning protection system is provided. There is passive ventilation in the form of two louvered vents in the front concrete face or in the door, as well as a single ventilation stack penetrating the earthen cover at the rear of the igloos. Fusible links in the vents close the ventilation path in the event of a fire. The igloo is designed to prevent water entry. A reinforced concrete “King Tut” block in front of each door acts as a security device. Within the storage igloos, chemical munitions at PCD are stored in boxes and pallets. Aisles are maintained so that units in each stack can be inspected, inventoried, and removed for maintenance as necessary.

2.2.4 Continued Maintenance, Handling, and Inspection

The U.S. Army Soldier and Biological Chemical Command oversees maintenance of chemical munitions. Oversight consists of those actions necessary to ensure availability of a chemical deterrent for national defense and to ensure continued safety in storage.

Routine activities associated with chemical agent storage at PCD consist of periodic inspection, surveillance, and inventorying of the containers and storage facilities. When inspected, both the containers and the storage area are visually examined, and the air is monitored for the presence of agent.

2.2.5 Treatment of Leaking Munitions

A few of the stored munitions have begun to leak. When agent is detected in a storage location, special procedures are followed to (1) identify the specific munition that is leaking, (2) remove the munition from storage, and (3) simultaneously decontaminate the individual munition, adjacent munitions, and other contaminated areas.

The leaking munition is placed into a barrier bag (a plastic wrap), which provides immediate agent containment. The wrapped munition is then placed into a munition-specific steel overpack designed to provide a high level of assurance of agent vapor and liquid containment, even if the munition were to continue to leak. Those munitions that are known to be leaking are placed in secure containers and stored in separate, state-permitted igloos.

2.3 GENERIC DESTRUCTION FACILITY REQUIREMENTS

2.3.1 Site Selection and Preparation

For the purposes of this NEPA assessment, it was assumed that, by virtue of the reuse plan requirements, all munitions destruction facilities would be constructed within the chemical demilitarization area located in the northeastern corner of the installation. This area encompasses G Block, the current munitions storage area.

The area within which destruction activities might occur was further limited by the presence of certain physical features in the chemical demilitarization area, such as the installation’s north boundary fence and the upper reaches of Haynes and Boone creeks (Fig. 2.3). To avoid locating the facility adjacent to the installation boundary or within a surface water drainage area, the areas considered for locating a destruction facility were limited to areas close to G Block, along its western, southern, and eastern edges. This region was subdivided into three areas to facilitate the NEPA analyses. These areas, labeled A, B, and C, are shown in Fig. 2.3. For construction of the destruction facility, gates would be installed in the existing security fencing along the perimeter of the chemical agent storage area to provide access to the demilitarization site which would also be surrounded by a double security fence.

The topography of the area consists of nearly flat terrain with a maximum slope of 1.1. Construction of the proposed PCD destruction facility would involve small amounts of excavation and fill work. Leftover construction debris would be transported to a commercial destruction site. The drainage system would be designed to divert surface runoff from the plant site and prevent erosion and surface water accumulation on the site. Minimal clearing, grubbing, and earthwork would be required because vegetation is sparse in this area and the land is relatively level. A detailed description of the soils and terrestrial biota that could be affected is presented in Sect. 4. All destruction alternatives would require clearing at least 8 ha (20 acres) for the facility. Additional area may be needed for construction operations.

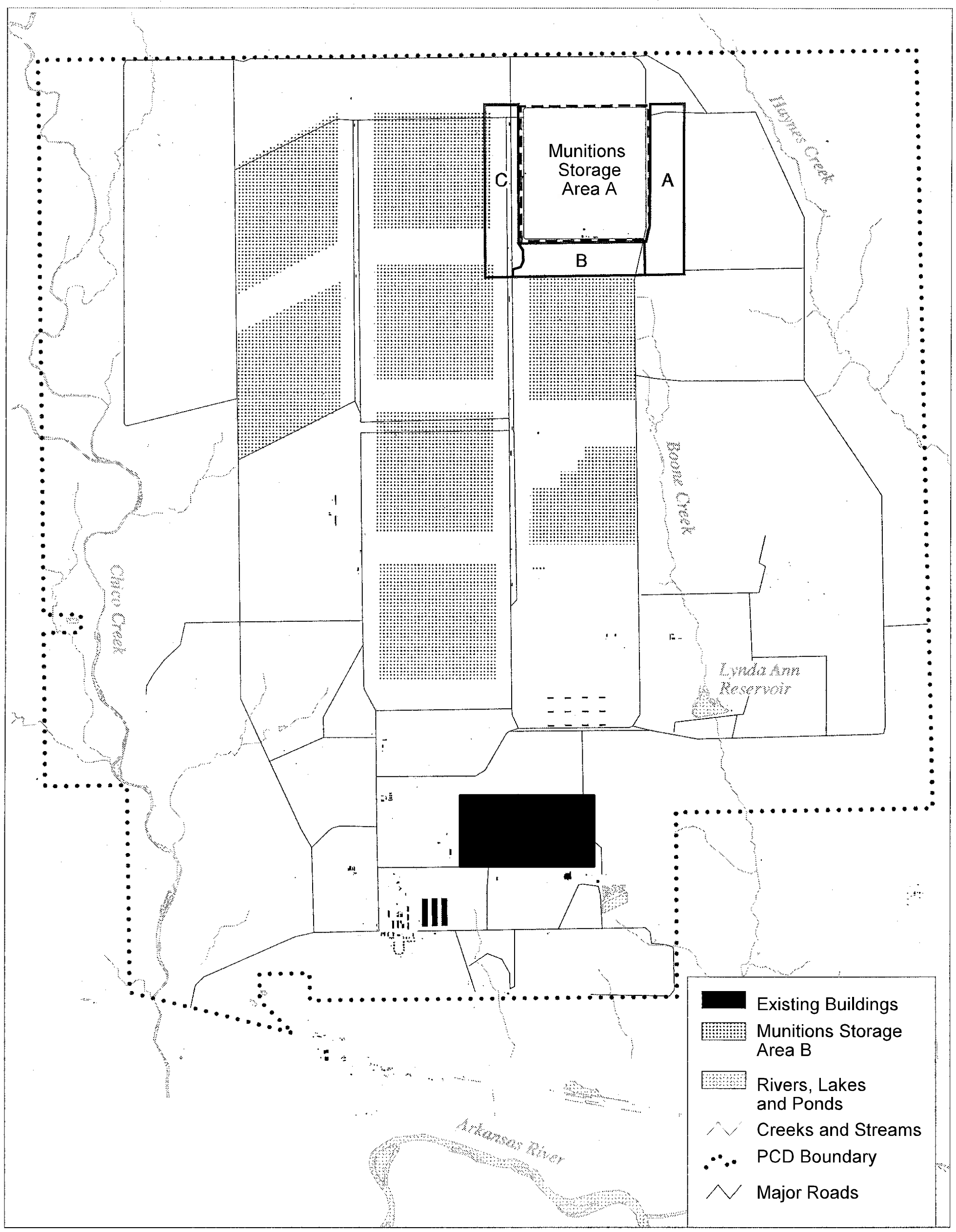


Figure 2.3. Alternative facility locations (A, B, and C) for the proposed destruction facility.

2.3.2 Utilities, Access Roads, and Support Facilities

Provision of utilities is required for each alternative, and the Army has developed plans for supporting that requirement. Other organizations have proposed alternate utility plans. Those options are being evaluated, and will be considered in reaching a final decision for implementation. See Section 3.1.3 for more detailed information.

Natural Gas. Natural gas would be provided to the site by tapping into the existing line at the Gas Regulator Station. Natural gas is provided to PCD by Xcel Energy, but service is available only in the installation housing, administrative, and warehouse areas.

Communications. The existing communication trunk lines serving PCD have inadequate capacity to support the destruction facility. A new line would be installed for the site by tapping into the existing line near the housing area.

Access Road. Approximately 4 miles of existing road within PCD would be improved and widened for use as "running routes" in transporting construction equipment and materials required for destruction operations to the proposed site. These same running routes would be used for removal of solid and liquid waste (hazardous and nonhazardous) including liquid brine wastes from the facility.

Electrical Power Substation. The existing electrical distribution system for PCD does not have the capacity to support the proposed destruction facility. A 13.2 KV electrical substation with redundant transformers would be constructed, and buried, power lines would be installed to connect the substation to the destruction facility. Electrical power would also be provided to the parking area, the sewage treatment facility, and the water supply pumphouse.

Personnel Support Building. A building would be constructed to house the administrative functions of the facility.

Parking. An employee/visitor parking lot would be constructed adjacent to the proposed facility on the south side of the site.

Waste Transfer Area. A waste transfer area would be constructed to provide temporary storage spaces for wastes awaiting transport to an approved destruction location.

Warehouse renovations. A warehouse would be required for storage of material. The current plan is to perform significant renovation to approximately 3,600 m^2 (40,000 ft^2) of existing warehouse space. If it is decided at a later date that it is not advantageous to renovate an existing warehouse, a new warehouse may be constructed within the chemical munitions fenced area.

Truck gate entrance upgrade. The existing truck gate entrance would be upgraded to allow for control and routing of traffic during construction. The current plan is to perform turn-around road and parking area repairs, fencing repairs, and improvements to the existing truck gate control booth.

Water. Destruction facility requirements for potable and process water will be provided by existing on-site wells.

Waste Water. Sanitary wastes will be treated, with effluent directed to evaporation lagoons. The only process liquid waste would be brines from the pollution abatement system (PAS) of an incineration facility. Brines would be transported off-site for disposal at a permitted facility.

2.3.3 Waste Management

Construction and operation of a chemical munitions destruction facility using any of the technologies (incineration or neutralization) being considered for implementation at PCD would produce hazardous and non-hazardous solid and liquid wastes (the neutralization technologies would have liquid hazardous wastes only after final processing has occurred). The PCD destruction facility operations, including waste management, would comply with all applicable federal, state, local, and Army regulations for air and water quality, solid waste, hazardous waste, and noise.

The state of Colorado has been delegated authority to oversee the federal programs for air and water quality and for most hazardous waste management requirements except those associated with the Hazardous and Solid Waste Amendments of 1984. Colorado adheres to the National Ambient Air Quality Standards (NAAQS) for the prevention of significant deterioration (PSD) of air quality.

2.3.4 Period of Operations

For either the baseline or modified incineration process, PMCD would begin construction upon issuance of required environmental permits (RCRA/air) from the State of Colorado and the U.S. Environmental Protection Agency (EPA), as well as a Certificate of Designation (CD), a zoning requirement, from Pueblo County. The currently projected timeframe for receipt of environmental permits is September 2002.

Systemization (i.e., trial burns and system checkout) of an incineration facility is projected to take about 1-1.5 years; however, systemization activities would start several months prior to the end of the construction phase. Modified incineration operations are expected to take 30 months, while baseline incineration would be expected to take about 65 months to destroy the PCD stockpile. The original estimates for Pueblo were based on the schedule that would meet the April 2007 Treaty deadline. A more realistic schedule and the resulting estimate have been developed for Pueblo Modified Baseline Incineration and the Pueblo Baseline Incineration. These were completed and provided to independent assessors and the Program Manager for Assembled Chemical Weapons Assessment on November 27, 2001.

The period of pilot test operations of the ACWA facility would vary (months to years), depending on developments during the test. It is estimated that complete destruction of the ACW stockpile at PCD by the ACWA neutralization alternatives would require about 3 years.

2.3.5 Future Use

In addition to the directive to destroy the U.S. stockpile, Public Law 99-145 also mandates the dismantling and disposal of the demilitarization equipment and buildings upon completion of the stockpile destruction activities. However, in November 1989, the House and Senate Appropriations Committee of Conferees, in Title VI of the 1990 Defense Appropriations Conference (DAC) Report 101-345, *Chemical Agents and Munitions Destruction, Defense*, directed the Army to investigate and report on the feasibility and desirability of using chemical weapons destruction facilities for other purposes after the stockpile is destroyed.

The proposed incineration facilities were found to be not well suited for many of the possible uses that were investigated, and no recommendation for future use was offered

(Goldfarb et al. 1991). The most feasible use appeared to be decontamination of munitions and items recovered from the previous chemical munitions burial grounds at PCD or non-stockpile chemical materiel (NSCM). The Army currently intends to dismantle and close the PCD facilities at the completion of destruction activities. Closure and decommissioning of the PCD destruction facility is addressed in Sect. 4.24 of this FEIS.

In October 1999, Congress modified federal law to remove the above prohibition if the state in which the chemical destruction facility (CDF) is located permits it. As a result, the Army is now studying the feasibility and cost-effectiveness of using the CDFs to destroy the NSCM that is also stored at the same location. The Army is not considering moving NSCM among CDF locations, nor is consideration being given to destroying buried NSCM that might be exhumed in the future (U.S. Army 2000).

The Army has tasked Mitretek Systems of McLean, Virginia, to conduct this independent study to determine the technical, cost, schedule, public acceptance, and environmental permitting issues associated with processing NSCM items that are collocated at the stockpile destruction facilities. The results of this evaluation will be compared to the technical, cost, schedule, public acceptance, permitting, and environmental issues associated with processing NSCM items in the transportable and other treatment systems that are being developed by the DOD Program Manager for NSCM.

The study is being conducted in two stages. Stage 1 involves an initial screening of the feasibility of using the CDFs to destroy NSCM stored at that location. The initial screening considers technical compatibility with the CDF and schedule compatibility with the 2007 CWC deadline, as well as an initial assessment of the political/public outlook regarding the acceptability of the Army implementing such a destruction activity (U.S. Army 2000). In a subsequent report (U.S. Army 2001), PMCD states that Mitretek's recommendation is to consider using the PCD stockpile destruction facility to destroy the small number of NSCM items located at PCD. PMCD agrees with the Mitretek recommendation and will consider the non-stockpile items in the facility design and RCRA permit application after the destruction technology is selected (U.S. Army 2001).

2.4 ON-SITE HANDLING AND TRANSPORTATION

The destruction process would begin with handling and loading of the munitions at the storage igloos in the existing storage area in preparation for their transport to the proposed destruction facility. A multistep process would be designed to ensure safety. Munitions would be transported by a method which would provide agent containment and would be as safe as reasonably achievable. A risk assessment of the transport methods is currently underway. Detailed procedures would be developed for handling of munitions (with and without energetic components) and transportation.

2.5 REFERENCES

CBDCOM, 1997. Solicitation No. DAAM01-97-R-0031, Chemical and Biological Defense Command, Aberdeen Proving Ground, Maryland, August.

EDAW, et al., 1995. *Pueblo Depot Activity Reuse Development Plan*, prepared for the Pueblo Area Council of Governments and U.S. Department of Defense, Office of Economic Adjustment by EDAW, Inc., San Francisco, Calif., Hammer, Siler, and George, Silver Springs, Md; and Wilson & Company, Topeka, Kansas.

Goldfarb, A. S., et al., 1991. *Engineering Analysis for Future Use of Chemical Agent Demilitarization Plants: Feasibility and Desirability*, Report MTR-91W00010, prepared for the U.S. Army by MITRE Corporation, McLean, Va.

PDAD (Pueblo Depot Activity Development authority) 2000. *Pueblo Chemical Depot Reuse Development Plan Update*. June.

SciTech, 1998. *Old Chemical Weapons Reference Guide, B103*, prepared by SciTech Services, Inc., Abingdon, Md., for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground. Md.

U.S. Army, 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1 to 3, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

U.S. Army, 1991. *Final Environmental Impact Statement: Realignment of Pueblo Depot Activity Colorado with Transfers to Tooele Army Depot, Utah and Red River Army Depot, Texas*, U.S. Army Corps of Engineers, Omaha District, Omaha, Ne.

U.S. Army 2000. *Mitretek Stage 1 Technical Report Assessment of Using Stockpile Disposal Facilities to Process Selected Non-Stockpile Chemical Materiel, Initial Screening, August 2000*, Program Manger for Chemical Demilitarization, Aberdeen Proving Ground, Md.

U.S. Army 2001. Proposed Approach Regarding the Use of Chemical Stockpile Facilities to Destroy Non-Stockpile Chemical Materiel, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

3 DESCRIPTION OF ALTERNATIVES

3.1 INTRODUCTION

This chapter describes the four alternatives being considered for destroying the stockpile of chemical weapons at Pueblo Chemical Depot. As required by NEPA, the no action alternative is presented to establish a basis for comparison even though it is not a viable alternative because its implementation is precluded by Public Law 99-145. Section 3.2 presents the four alternative destruction systems: baseline incineration, modified incineration, neutralization with biotreatment and neutralization with SCWO. Section 3.3 presents the specific process operations that make up the destruction systems. Section 3.4 presents the resource requirements and the routine emissions and wastes from the individual destruction systems. Section 3.5 presents the no action alternative.

The information presented concerning the two neutralization alternatives has been provided by the U.S. Army ACWA program. The data presented for the ACWA alternatives is taken from the ACWA Technology Resources Document (May 2001). The technologies are currently under development, and if either is selected it would be operated initially as a pilot test.

All the alternative destruction systems provide for the complete destruction of the chemical weapons stockpile at PCD. The systems accomplish this destruction by using the following interrelated processes: opening the weapons; treating/disposing of the agent, energetics, metal parts, and dunnage; and controlling pollution. The following definitions are employed in discussing the alternatives.

Installation: The Army depot where the chemical weapons stockpile is stored. This term includes both chemical weapons and non–chemical weapons areas. It is the entire parcel of land owned by the U.S. Government.

Site: The location on the installation where the chemical weapons stockpile is stored and the location where the destruction structure would be built.

Facility: The structure to be built at the site to implement stockpile destruction.

System: A complete approach to weapons destruction that includes disassembling a munition, destroying agent and energetics, treating component parts (e.g., metal and dunnage), and managing and disposing of effluents. Each system may potentially be considered an alternative action under NEPA.

Process: A category of activity that contributes to a total system. The process categories are munitions access, agent treatment, energetics treatment, dunnage treatment, metal parts treatment, and effluent management/pollution controls.

Technology: The technique or techniques for accomplishing each process. There may be more than one technology involved in a process. In addition, the same (or a similar) technology may be used in multiple processes.

Figure 3.1 illustrates the hierarchy of use of these terms in this analyses.

3.1.1 Processes Required for Chemical Weapons Destruction

Each of the alternatives being considered for destruction of the munitions and chemical agent stored at PCD are designed to accommodate four categories of materials: agent, energetics, metal parts, and dunnage (materials including wooden pallets and boxes, metal straps, and packaging are collectively called dunnage). The major processes being considered to accomplish this task using any of the incineration or neutralization technologies are illustrated conceptually in Fig. 3.2. The first step, munitions disassembly (i.e., opening the munition), is common to each of the technologies being considered, although some modifications of the baseline process have been proposed, based on the experience gained at JACADS.

After the munitions are disassembled, the components can be separated into materials streams for processing. The materials streams are energetics, agent, metal munition bodies, and dunnage. However, modified incineration does not separate the agent and metal parts streams. Under the modified incineration alternative, the agent is frozen and remains in the metal munition bodies. Destruction of these material streams is addressed in process–specific sections: baseline incineration (Sect. 3.2.1), modified incineration (Sect. 3.2.2), neutralization/biotreatment (Sect. 3.2.3), and neutralization with SCWO (Sect. 3.2.4).

In addition to the primary waste streams, there would be technology-neutral and process–specific secondary wastes. The technology-neutral secondary wastes would include demilitarization protective ensemble (DPE), spent decontamination solution (SDS), and tools. For incineration, these secondary wastes include liquid brine salts from the pollution abatement system (PAS), incinerator residues, and charcoal from charcoal filters. The secondary ACWA wastes include spent carbon and solid salt and charcoal from charcoal filters. The secondary wastes would be disposed of off-site in accordance with all applicable regulations (see Sects. 3.4.2 and 4.6).

3.1.2 Containment Structure and Facility Size

The destruction of the chemical weapons stockpile at PCD would take place in structures designed to prevent release of mustard agent to the environment. Disassembly and disposal of energetics (if conducted on-site) would be carried out in an explosion containment area. The overall structure would be designed for agent containment using features such as air locks and negative differential air pressure. Gases from the ventilation systems would pass through a series of filters, and process gases would pass through a system to minimize pollutants before being released from the structure.

The main building would be constructed of noncombustible materials with a concrete structural frame and a low–slope concrete roof. This building would contain equipment and systems for munitions disassembly, processing of contents and components, and pollution

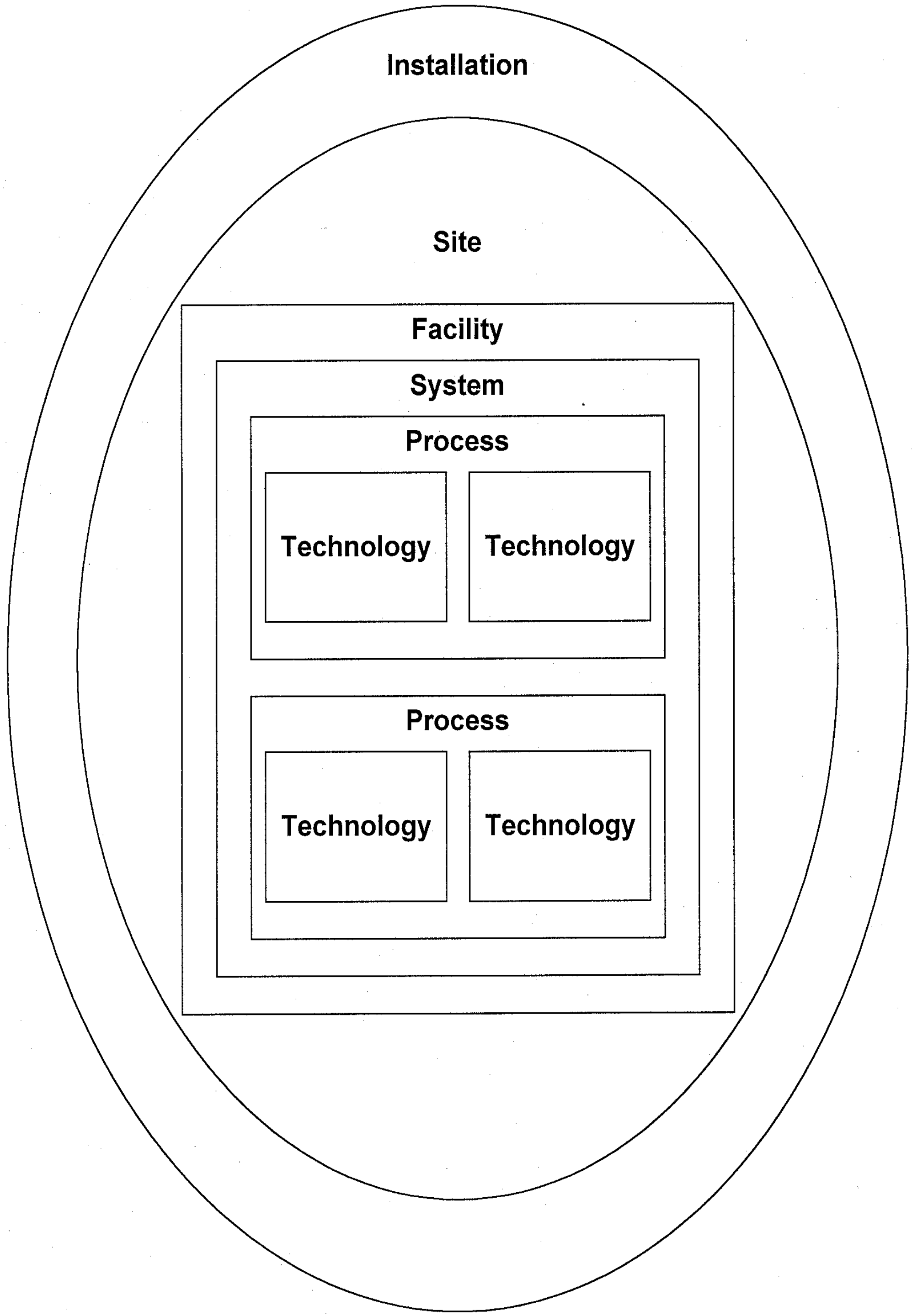


Figure 3.1. Hierarchy of analysis.

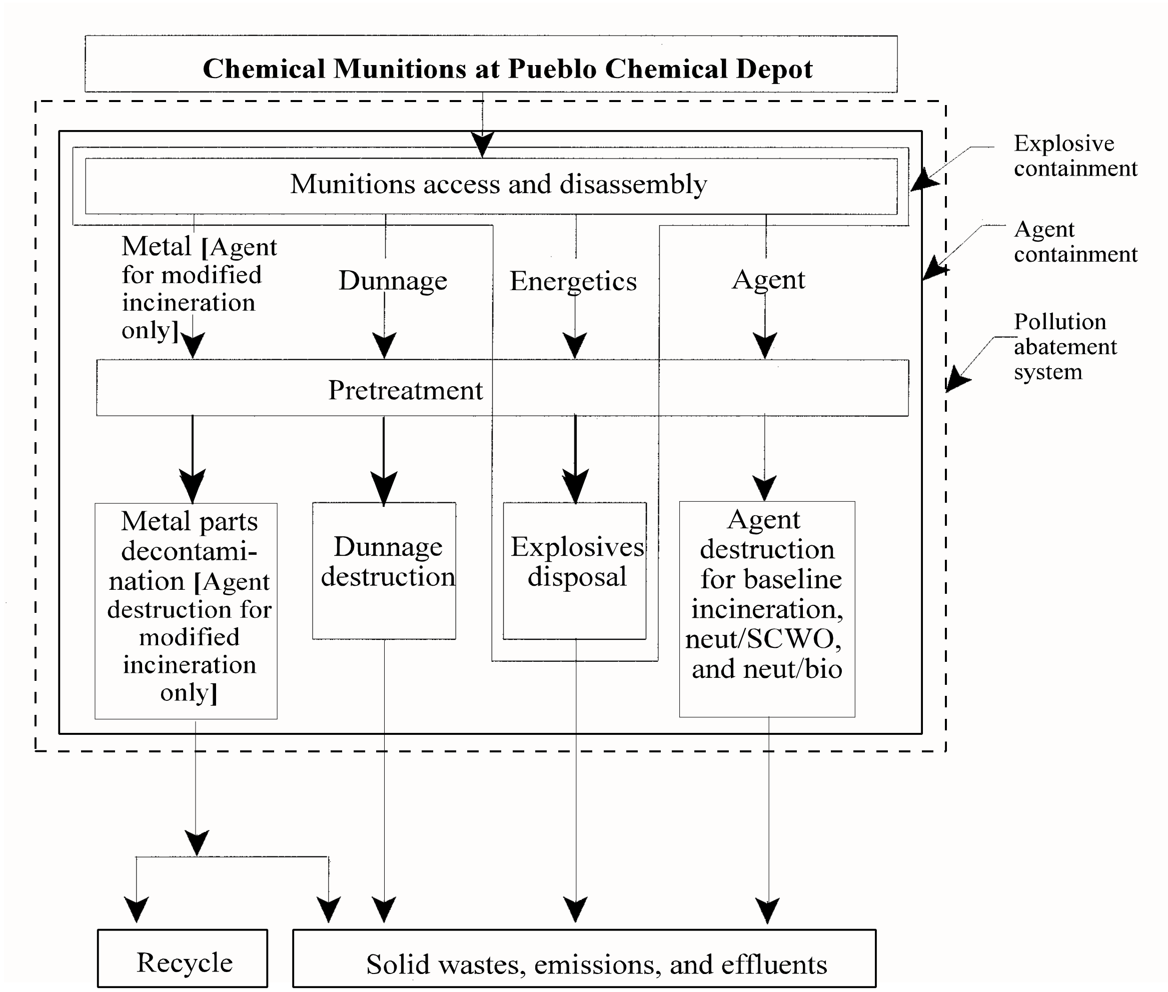


Figure 3.2. Generic processes for destroying the Pueblo stockpile.

abatement. There would also be a separate chemical analysis laboratory and buildings for support of personnel and maintenance.

The facility footprint would require approximately 20 acres. Additional area may be required for construction operations. With storm–water management and upgrade of access roads and utilities, up to 85 acres may be disturbed.

3.1.3 Technology Neutral Infrastructure Projects

The Army has determined that improvements to the PCD infrastructure must be made to support the destruction of the chemical weapons inventory. These improvements are technology neutral, i.e., they would be needed by whichever alternative destruction system is built at PCD and could potentially benefit the reuse plan for the depot.

3.1.3.1 Gas Service Line

Natural gas service would be provided to an interface point, which would allow the future hookup of the site. Approximately 4 miles of high pressure pipe would be installed. The pipe would follow the existing roadway easement north to the interface point just south of the site. The gas line would be buried in the shoulder of the access road next to the communications transmission line.

3.1.3.2 Communications Service Line

Communications service would be provided to an interface point, which would allow the future hookup of the site. Approximately four miles of 24–strand, single–mode, fiber optic cable would be installed. The origination point would be near the PCD housing area; the cable would follow the existing roadway easement north to an interface building just south of the site. The communications line would be buried in the shoulder of the road next to the gas transmission line.

3.1.3.3 Access Road to the Site

Approximately four miles of existing PCD road from the entrance gate to just short of the entrance to the site would be widened and improved. It is anticipated that the existing road would be widened to a minimum of 24 feet with shoulders and a minimum 3-inch asphalt surface. All the road widening would occur on the west side of the existing roadway.

3.1.3.4 Electrical Substation Power Service

An electrical substation would be installed to provide power service to the destruction facility and potential locations are under consideration. The substation would support a power load of 15 megavolt-amps at 13,200 volts with a 3-phase, 3-wire power system. The utility lines would extend approximately 1.5 miles directly across PCD from the eastern border of the installation to the site, or could connect with a north-south running utility corridor at a more southerly point.

3.1.3.5 Personnel Support Facility

A building would be constructed to house the administrative functions of the destruction facility when in operation and to serve as a management facility during design/construction and systemization. It is anticipated that the building would have approximately 12,800 ft^2 of office facilities.

3.1.3.6 Personnel Support Facility Parking

A parking area would be constructed to support the facility described in Sect. 3.1.3.5. The parking area would accommodate 236 automobiles/small trucks and 5 buses.

3.1.3.7 Waste Transfer Area

A paved area would be constructed in close proximity to the parking area described in Sect. 3.1.3.6. This paved area would support the temporary storage and removal of waste when the destruction facility is operating and would serve as an overflow parking area during design/construction and systemization. The 110,000 ft^2 area would be curbed and made of concrete.

No wastes would be stored in the Waste Transfer Area. Solid wastes are stored in 55-gal drums within the MDB until transportation is ready. The drums are moved to the Waste Transfer Area and loaded on the truck. Brine is pumped through pipes from brine tanks within the MDB to the tanker truck in the Waste Transfer Area. Trucks would leave promptly after being loaded. Because no wastes would be stored in the Waste Transfer Area, no permits would be required.

3.1.3.8 Warehouse Renovations

An existing PCD warehouse would be renovated to support parts storage during destruction facility operations. The renovated warehouse may be used for storage. Approximately 40,000 ft^2 of existing warehouse space would receive renovations to the loading dock, the roof, and the electrical, communications, and HVAC systems. If it is not advantageous to renovate an existing warehouse, a new warehouse would be constructed within the previously disturbed area of G-Block (Fig. 2.5).

3.1.3.9 Main Gate Entrance Upgrade

The existing main gate entrance at PCD would be upgraded to allow for control and routing of traffic during construction. Repairs would be performed to fencing, the parking area, and the turn-around road. The control booth would be improved by repairing existing systems including HVAC, water, electrical, sanitary, and security.

3.2 DESTRUCTION SYSTEMS

3.2.1 Baseline Incineration

Baseline incineration systems are currently being operated on Johnston Island in the Pacific Ocean and at DCD (formerly Tooele Depot, South) near Tooele, Utah. JACADS completed destruction of the Johnston Island stockpile in November 2000.

After disassembly, the metal munition bodies and mustard agent (HD and HT) are thermally treated in different types of incinerators. Destruction takes place within a two-story structure designed to contain any leakage of the mustard agent. The mustard agent and energetics are separated from the metal parts within that structure. The energetics may be shipped off-site to a permitted TSDF, or disposed of on-site in a rotary-kiln deactivation furnace (DFS) that is contained within a reinforced, explosive-containment structure. Liquid mustard agent is transferred to the liquid-injection incinerator for destruction. Metal parts, which may contain residual mustard agent, are treated in a roller hearth metal parts furnace

(MPF). Contaminated dunnage is size–reduced before incineration. In addition to the primary chamber, all of the incinerators have a secondary chamber to destroy any residual mustard agent or other organic compounds not incinerated in the primary chamber. To ensure that full facility throughput may occur when the ambient temperature is below 54°F, a mustard thaw facility is provided. See Appendix D for more detailed process information. Appendix C contains information about the Army's experience with incinerating chemical agents.

The lessons learned from operating two baseline incineration facilities suggest that PCD-specific changes should be made in the baseline incineration systems. The PCD inventory is quite stable and consists of munitions containing only mustard agent. The inventory would be transported in a manner that has not yet been determined, but that will be as safe as reasonably possible (see Appendix D). Energetics would be removed before the munitions are processed at the munitions destruction building (MDB). Prompted by operating difficulties encountered at JACADS and TOCDF, the incinerator designated for dunnage would be eliminated. Also, to substantially reduce costs, liquid scrubber brine salts would not be dried, but would be shipped to an off-site TSDF in liquid form.

The dunnage incinerator (DUN) was operated at JACADS from mid 1989 to mid 1996. The DUN was primarily used to process the dunnage and to a limited extent, to co-process wood and charcoal and other miscellaneous wastes in small quantities. In 1994, a trial burn test with GB agent and wood was conducted. The results of the trial burn verified that the DUN performed well within the RCRA-defined parameters. However, stable and reliable operations were difficult to sustain, and significant resources were required to maintain the DUN.

DUN operations were eventually discontinued at JACADS primarily for economic reasons. Uncontaminated dunnage could be shipped off-site or reused for offsite transfer of demilitarized projectile casings. This approach is also being taken at TOCDF in Utah. The amount of contaminated dunnage generated at JACADS and TOCDF has been very small and can be treated in the MPF. The miscellaneous wastes that might be agent contaminated and were originally intended to be processed in the DUN would be treated in the MPF or DFS.

At JACADS, reduction of the brine to salts became a major rate limiting step during the 4.2-inch HD mortar round campaign. The high metals content in the brine required that the brine be processed at a reduced rate in the BRA to ensure regulatory compliance. In addition, a greater quantity of brine was produced per lb of mustard destroyed. Each mortar round generated 8-12 gallons of brine. The feed rate limitation, coupled with the production of increased quantities of brine resulted in the BRA becoming the rate limiting system during the MPF shakedown period. In addition, operation and maintenance requirements for the BRA were extensive.

Because of these difficulties encountered at JACADS, a review of off-site disposal options versus construction and operation of a BRA was performed for the proposed PCD modified baseline incineration facility. If a BRA were to be implemented at Pueblo, the brine would likely require a pre-treatment step to remove heavy metals prior to treatment in the BRA. In addition, the resulting salts would have to be disposed of as a hazardous waste. Based on a cost analysis, it was determined that it would be more economical and efficient to ship the brine to a hazardous waste TSDF. This is also the approach that is currently being employed at TOCDF.

Scrubbers, high efficiency particulate air (HEPA) filters, and charcoal filters would be used to control emissions to the air. The primary waste materials from the system consist of scrubber brines, incinerator residue (ash and slag), and charcoal from charcoal filters. After treatment, which may be required to reduce leaching of heavy metals, the brines, incinerator ash, and slag would be disposed of in a permitted treatment, storage and disposal facility (TSDF).

3.2.2 Modified incineration

The Army has 15 years of successful experience in building and operating facilities to destroy chemical munitions by incineration, most notably at JACADS. Modified incineration would retain the lessons learned changes from baseline incineration noted in Sect. 3.2.1. Additionally, as tested at Johnston Atoll, agent would be frozen in the munition and would not be drained. There would be no need for the liquid-injection incinerator, allowing for all operations to be performed on a single level. A single-story facility could be built more rapidly and inexpensively than a two-story facility required for baseline incineration.

The modified incineration system would differ from the baseline system in the following process steps:

- agent access—Inert munitions (munitions from which energetics have been removed) would be frozen and the fuze adapter would be pressed into the agent cavity to provide access to the agent
- agent destruction and metal parts decontamination—Agent and metal parts would be treated (incinerated) together
- single story—All agent-related operations are conducted on a single level.

After disassembly, the chemical munitions bodies and mustard agent would be thermally treated in the same incinerator. The munitions would be frozen and then cut open to expose the frozen mustard agent. The metal parts and frozen mustard agent would be treated in a roller hearth MPF. Destruction would take place within a structure designed to contain any leakage of the mustard agent. The energetics may be shipped to a permitted off-site TSDF or incinerated in a rotary-kiln DFS or other destruction system within a reinforced, explosive-containment structure. Contaminated dunnage would be size–reduced before incineration. In addition to the primary chamber, both incinerators would have a secondary chamber to destroy any residual mustard agent not incinerated in the primary chamber. See Appendix D for more detailed process information.

There is no DUN proposed for the modified baseline facility. As was done at JACADS and is being done at TOCDF, uncontaminated dunnage would be shipped offsite. Contaminated dunnage (small quantities only if experience at PUCDF parallels that at JACADS and TOCDF) and miscellaneous wastes that might be agent contaminated would be processed in the MPF. The details of dunnage characterization would be coordinated with the State of Colorado but are expected to be similar to TOCDF procedures. Approximately 10% of the MPF availability is currently scheduled for secondary waste treatment.

3.2.3 Neutralization and Biotreatment System

For the neutralization with biotreatment system, the munitions would be transported to the destruction facility in a manner that will be as safe as reasonably achievable. The munitions would then be disassembled using a process similar to that used by the baseline incineration system. Following disassembly, the energetics and mustard agent would be chemically treated (neutralized), and the resulting chemicals (hydrolysate) would be rendered harmless using biotreatment a process that is conceptually similar to the process used in a sewage treatment plant. Metal parts and dunnage would be treated either chemically or thermally. Additional detail is presented in Appendix E, and more information will be provided as the facility design becomes more complete.

3.2.4 Neutralization and Supercritical Water Oxidation System

In the neutralization with SCWO system, the munitions would be transported to the destruction facility in a manner that is as safe as reasonably achievable. The munitions would then be disassembled using a process similar to that used by the baseline incineration system. The munitions bodies containing agent would be frozen in liquid nitrogen and fractured (cryofracture) for neutralization. The energetics and mustard agent would be chemically treated (neutralized), and the resulting chemicals (hydrolysate) would be broken down by high temperature and pressure in SCWO units. Dunnage would be chemically treated and then processed through a SCWO unit. Metal pieces would be treated thermally. Additional detail is provided in Appendix E, and more information will be presented as the facility design becomes more complete. The facility design is evolving and current engineering documentation is not citeable.

3.3 PROCESS OPERATIONS

3.3.1 Removal from Storage

Before the storage igloos would be entered the interior would be monitored. The munitions would then be monitored to determine if they are safe for transport. If unsafe munitions are identified, they would be overpacked and made safe for transport.

For all the destruction systems, the destruction process would begin with the removal of the munitions on pallets from the storage igloos. Munitions would be safely transported to the destruction facility. A risk assessment concerning the alternatives for transporting the munitions is currently under way. Regardless of the method selected, munitions will be transported in a manner that will be a safe as reasonably possible (see Appendix D). All movement of munitions from the storage site to the destruction facility would be within the boundaries of the munitions storage area and the destruction facility site. Monitoring and movement would conform to all applicable safety guidelines and regulations.

3.3.2 Disassembly Process

With regard to the chemical weapons stored at PCD, the term disassembly refers to the steps taken to separate the mustard agent and energetics from the metal casing and other metal parts. The first step of the disassembly process would be to remove the energetics. Based on the JACADS experience, it is difficult to remove the burster well and drain the mustard agent from the projectile. The fuzes and bursters would be removed by using 3 projectile/mortar disassembly machines (PMDs) to be installed in the MDB. Energetic components (fuzes, bursters, and propellants) may be shipped to an appropriately permitted off-site TSDF or destroyed on-site. Both options are addressed in the following assessment of impacts. For baseline incineration, the second (and last) step of the disassembly process is draining the mustard agent into a holding tank. The second and third steps of the disassembly process for the modified incineration system would be to freeze the mustard agent within the munitions to -20° to -10°F in freezer units and cut open the munitions.

The neutralization with biotreatment alternative would accomplish energetics removal at the beginning of the destruction process by using robotic reverse assembly, which includes two steps shared with baseline incineration: (1) reverse assembly by removal of the burster well to access the mustard agent, and (2) draining of the mustard agent. The remaining steps of disassembly for neutralization with biotreatment are to cut open the munitions and wash out the agent and energetics.

The Neut/SCWO process incorporates the freezing of munitions. After going through the projectile/mortar disassembly machine (PMD) to remove the energetics, the munitions are frozen in a liquid nitrogen bath. Following this cryobath, the rounds are crushed in a press using several hundred tons of pressure and the resulting mass (including frozen agent) is directly fed to the projectile rotary hydrolyzer. This process does not require the use of a Multipurpose Demilitarization Machine (MDM) for agent cavity access.

The Neut/Bio process does not freeze munitions. After the PMD removes the energetics from the rounds, these rounds will go to a modified MDM. The ACWA modified MDM will be designed to handle any frothing or spraying mustard with a catch-basin for liquids integrated into the turntable of the MDM. For the mortars, the base will be cut off allowing the mustard to gravity drain with the remaining residue being washed out with high pressure water. For the remaining projectiles, the munition will be inverted, the burster well pulled so that the agent can gravity drain, and the cavity is then washed out while the projectile is inverted. Frothing or spraying mustard munitions will be drained in this inverted position.

3.3.3 Destruction Process

3.3.3.1 Baseline incineration process

There are four incineration steps in the baseline incineration process: incineration (destruction) of liquid mustard agent, deactivation of energetics, decontamination of metal parts (raise the temperature above 1000°F for 15 min), and decontamination/disposal of dunnage. Each of these incineration processes is conducted in a furnace (incinerator) designed specifically for the physical form and chemical characteristics of the expected incoming materials. For additional details, see Appendix D. All four incineration processes operate between 1000 and 1500°F to ensure the destruction of mustard agent. Each incinerator has a secondary incinerator (afterburner) through which the exhaust gases must flow. The afterburner operates at 2000°F with a residence time of at least 1.0 sec to destroy any mustard agent or other organic compounds which exit the primary incinerator. Before being released to the atmosphere the exhaust gases from the afterburner are treated in a pollution abatement system, which has a filtration system at its outlet. Uncontaminated dunnage would not be incinerated. It would be stored and transported to an appropriately permitted off-site disposal facility. Contaminated dunnage would be destroyed in the metal parts furnace or the deactivation furnace.

Destruction of energetics would be accomplished differently for uncontaminated and mustard agent-contaminated components. After agreements are reached with CDPHE, EPA, other involved states, and the receiving TSDFs such as Hawthorne, Nevada, the uncontaminated energetics would be shipped off-site to the TSDFs where the components would be destroyed. Mustard agent-contaminated energetics would be destroyed on-site. A deactivation furnace may not be constructed; but it will be assumed for this FEIS that destruction of contaminated components would occur in a deactivation furnace. Several methods are being evaluated for the on-site destruction of contaminated energetics: a blast chamber, a Donovan chamber, and a DFS. A decision on the chosen destruction method is expected to be reached in November 2001 after all evaluations have been completed.

3.3.3.2 Modified incineration process

The furnace for destroying mustard agent and decontaminating metal munition bodies would be similar to the baseline furnace which would decontaminate metal parts. However, the modified incineration furnace would have additional heating capacity to accommodate the munition bodies and the frozen mustard agent, which enters the furnace still contained within the opened munition bodies. For additional details about the modified incineration processes, see Appendix D. As with the baseline incinerator processes, the furnace would have an afterburner that operates at 2000°F with a residence time of at least 1.0 sec to destroy any mustard agent or other organic compounds which exit the incinerator. As for the baseline incineration process, the afterburner is followed by a pollution abatement system, which has a filtration system at its outlet. Dunnage and energetics would be destroyed/disposed of similarly to the methods used for the baseline incineration process: uncontaminated materials would go to permitted off-site disposal/destruction facilities and contaminated materials would be destroyed on-site. Samples of the dunnage and energetics would be collected. The samples would be analyzed for agent concentration in the on-site laboratory. If the agent concentration is less than 200 ppb (Army waste control limit for mustard agent), the waste meets the Army's criterion for uncontaminated. If the mustard agent concentration is equal to or greater than 200 ppb, the Army would consider the waste to be contaminated. For more information on the 200 ppb criterion, see Appendix D.

3.3.3.3 Neutralization with biotreatment process

Neutralization (hydrolysis) is the agent destruction process which is common to both the ACWA destruction systems. The process uses hot water followed by caustic solution (sodium hydroxide in water) to break down mustard agent and reduce the hazards of energetic compounds. The resulting material (hydrolysate) must be treated further by either biotreatment or SCWO.

The biotreatment process would use microbiological organisms to break down complex organic compounds to simpler materials: carbon dioxide, water, nitrates, and phosphates, as well as other organic material. The process would produce a sludge which would be prepared for disposal using ordinary wastewater (sewage) treatment processes. The neutralization/ biotreatment system would use thermal treatment processes to decontaminate dunnage and metal parts (raise the temperature above 1000°F for 15 min).

3.3.3.4 Neutralization with SCWO process

Neutralization with SCWO has the same neutralization process as described above, Section 3.3.3.3. SCWO is a thermal–oxidation process that takes place at temperatures and pressures above the critical point of water (temperature >700°F and pressure >210 atmospheres). Both mustard agent and energetics tend to break down under these conditions. The process would produce both gases and liquids. The solution would be dried to remove salts and other materials; these would be treated as needed prior to disposal. The neutralization/SCWO system would use thermal treatment processes to decontaminate metal parts only. Potential processes include using steam, hot gas, or radiant heat.

3.3.4 Pollution Abatement and Waste Handling Processes

The effluents from all the chemical munitions destruction alternatives would include gases and solids. The modified and baseline incineration systems would also have liquid effluents. Both ACWA systems would recycle their process liquids. Plant ventilation systems would be designed to cascade airflow from areas least likely to be contaminated to those where there would be a greater possibility of contamination. Air pollution would be controlled by using filters (HEPA and activated charcoal) and liquid scrubbers. Additionally, air pollution resulting from operation of either of the ACWA systems would be controlled by using catalytic purifiers (similar to automotive catalytic converters). Both ACWA systems could hold and test ventilation air before releasing it through the pollution control processes.

Solid residues, such as salts, would be considered hazardous wastes if they are derived from a listed waste or if they leach heavy metals above levels allowed by the RCRA Toxicity Characteristic Leaching Procedure (TCLP). Liquid wastes which fail the TCLP or are derived from a listed waste would be considered hazardous wastes. (Colorado has classified all demilitarization residues as hazardous wastes.) Stabilization of these waste forms would be required before they would be disposed of in a permitted hazardous waste disposal facility. Metal parts would be treated sufficiently and then recycled.

3.4 INPUTS AND OUTPUTS

3.4.1 Resource Requirements

The estimates of resource requirements that follow are not exact but provide an envelope for possible levels of annual throughput. Resource use could differ from the estimates presented here due to downtime for maintenance or operating less than 24 hours per day, 7 days per week.

Table 3.1 presents estimated resource requirements for all four alternatives. For the incineration processes, 24-hr/day, 7-day/week operations are assumed. Operations of the neutralization alternatives would be on a 12-hr/day, 6-day/week, 46-week/year basis, with the remainder of the time set aside for equipment maintenance and other activities.

3.4.2 Routine Emissions and Wastes

3.4.2.1 Incineration processes

Air emissions and liquid and solid wastes are the main components of waste from the incineration process. Ventilation air would pass through a series of filters and be monitored before release to the atmosphere. Process gases would pass through a pollution abatement system and be monitored before release to the atmosphere. Sanitary wastes and liquid brines would be the liquid effluents expected from the facility. Agent-contaminated liquid laboratory wastes (200 ppb or higher concentrations of mustard agent) would be decontaminated until the concentration of mustard agent is less than 200 ppb (see Appendix D). Liquid laboratory waste and decontaminated liquid laboratory waste containing less than 200 ppb mustard agent would be shipped off-site to an appropriately permitted facility for treatment and disposal. Liquid and solid wastes identified as hazardous would be stored and disposed of in accordance with RCRA requirements.

It is expected that decontaminated metal would be sold for recycling. Nonhazardous solid wastes would be disposed of in a commercial landfill.

3.4.2.2 Neutralization processes

Air emissions and solid wastes are the main components of waste from the neutralization process. Ventilation air and process gases would pass through a pollution abatement system and be monitored before release to the atmosphere. Biotreatment vapors would be passed through a catalytic oxidation system prior to release to the atmosphere; for these vapors, there would be no charcoal filtration. Liquid laboratory wastes would be processed by neutralization followed by biotreatment or SCWO, as appropriate. Sanitary wastes would be the only liquid effluent expected from the facility. Solid wastes identified as hazardous would be stored and disposed of in accordance with RCRA requirements.

It is expected that decontaminated metal would be sold for recycling. Nonhazardous solid wastes would be disposed of in a commercial landfill.

Table 3.1. Approximate annual input requirements

Input	Baseline Incineration	Modified incineration	Neutralization/biotreatment	Neutralization/SCWO
Electric power (GWh)	29	26	36	60
Natural gas (ft^3)	392,000,000	199,000,000	94,000,000	149,000,000
Fuel oil (gal)	1,400,000	1,400,000	265,000	265,000
Potable water (gal)	6,400,000	6,400,000	6,400,000	6,400,000
Process water (gal)	9,700,000	7,900,000	5,700,000	1,300,000

GWh = gigawatt·hr

Conversion factors:
1 ft^3 = 0.028 m^3
1 gal = 3.8 L
1 ton =0.91 metric ton

Source: For the incineration alternatives, U.S. Army 2000b and personal communication from Penny Robitaille, PMCD, to Tim Ensminger, ORNL, January 7, 2002. For the neutralization alternatives, ANL 2001b.

3.5 NO ACTION ALTERNATIVE

No action would be continued safe storage of the chemical munitions stockpile at PCD. Current safety procedures for storage and maintenance would continue to be followed, including monitoring and surveillance.

Hazards associated with this alternative derive from (1) handling in the course of inspection and maintenance activities, (2) external hazardous events (e.g., earthquake, airplane crash), and (3) continued degradation of the agent containers (U.S. Army 1988).

3.6 SUMMARY COMPARISON OF POTENTIAL IMPACTS

This section provides a comparative summary of the potential impacts of alternative technologies for carrying out the construction, operation, and closure of a facility to destroy the chemical munitions currently stored at PCD. The impacts of the alternatives are addressed in greater detail in Section 4. The four alternative technologies for destruction of the chemical munitions stockpile at PCD, as described in the earlier portions of Section 3, are: (1) baseline incineration, (2) modified incineration, (3) neutralization followed by biotreatment, and (4) neutralization followed by SCWO. The potential impacts of these alternatives are summarized and compared in Table 3.2 along with the impacts of no-action (i.e., continued storage and maintenance of mustard filled munitions at PCD) as required by NEPA.

3.7 REFERENCES

SciTech 1998. *Old Chemical Weapons Reference Guide, B103*, prepared by SciTech Services, Inc., Abingdon, Md., for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement* (Vols. 1, 2, and 3), Program Executive Officer—Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

Table 3.2. Summary and comparison of the impacts of all alternatives

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action
			Impacts of Construction		
Land use	Construction in previously disturbed areas. Facility footprint 20 ac, with up to 85 ac disturbed; <1% of PCD land.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No changes in current land use.
Water supply and use	Water used for preparing concrete, rinsing, potable, and sanitary use, etc. Negligible impacts.	Impacts smaller than baseline incineration because of single story facility.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No changes to existing water supply and use.
Electrical power	Electrical power needs are not expected to exceed existing capacity. System would be upgraded.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No change in electrical power use. System upgrades would not be installed.
Natural gas	None used during construction. Installation of natural gas line along existing roadway.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No changes to natural gas supply and use. Upgrades would not be installed.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action Alternative
Waste management	Typical construction wastes would be disposed of in accordance with Army, state, and federal requirements.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No construction wastes would be produced.
Air Quality	No exceedances of NAAQS expected. Temporary, localized increases in PM-10, NO_2, CO, SO_2, and VOCs from vehicles and equipment.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No construction; hence, no impacts to air quality.
Human health	Typical occupational hazards. Based on estimated workers and construction period, no deaths and up to 60 injuries could be expected.	Typical occupational hazards. Based on estimated workers and construction period, no deaths and up to 45 injuries could be expected.	Typical occupational hazards. Based on estimated workers and construction period, no deaths and up to 48 injuries could be expected.	Typical occupational hazards. Based on estimated workers and construction period, no deaths and up to 57 injuries could be expected.	Worker risks associated with continued storage and maintenance of stockpile would continue.
Noise	Noise impacts would be minimal at residences near PCD.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No changes in current noise levels.
Visual resources	Construction in industrial area, not highly visible to off-post viewers. Impacts negligible.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No changes in current visual character of PCD.
Geology and soils	Soils used for backfill; small impacts.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No construction; hence, no use of soils or mineral resources.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action Alternative
Groundwater	Small volume of groundwater depletion with negligible impacts.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Groundwater use would remain the same.
Surface water	No on or off-post impacts expected. Erosion control, spill, and leak prevention measures in effect.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No construction; hence no impacts to surface water.
Terrestrial Ecology	Site can be chosen within areas A, B, and C to avoid undisturbed vegetation and habitats. Temporary disturbance of fauna by construction activities and noise.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No construction; hence no impacts to terrestrial ecology.
Aquatic Ecology	No aquatic resources or wetlands in construction area. Impacts negligible with implementation of erosion control and spill response.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No construction; hence no impacts to aquatic ecology.
Protected Species	Negligible impacts on protected aquatic species.	Similar impacts to baseline incineration.	Similar impacts to baseline incineration.	Similar impacts to baseline incineration.	No changes.
Wetlands	Negligible impacts on wetlands and their biotic communities.	Similar impacts to baseline incineration.	Similar impacts to baseline incineration.	Similar impacts to baseline incineration.	No changes.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action Alternative
Archaeological cultural and historic resources	Based on previous survey results and high level of prior disturbance in the project area, no impacts are expected.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No construction; hence, no impacts to resources.
Socioeconomic resources	No significant impacts to public services, housing, or infrastructure. Direct and indirect employment 980; inmigration of up to 584; income $30.7 million.	No significant impacts to public services, housing, or infrastructure. Direct and indirect employment 736; inmigration of up to 439; income $23.1 million.	No significant impacts to public services, housing, or infrastructure. Direct and indirect employment 1,328; inmigration of up to 1013; income $33.2 million.	No significant impacts to public services, housing, or infrastructure. Direct and indirect employment 1,487; inmigration of up to 1153; income $35.4 million.	No construction; hence no changes in socioeconomic impacts.
Environmental justice	No adverse health or environmental effects to minority or low income populations. Could provide jobs and income to subgroups of area.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No construction; hence, no impacts.
			Impacts of Operation		
Land use	No significant impacts to on or off-post land use. Complies with 2000 Reuse Development Plan.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	Impacts similar to baseline incineration.	No changes in current land use.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action Alternative
Water supply and use	Annual process water use volume, 9,729,000 gal; based on 24 hr/d, 6 d/wk operations. Less than historic high usage, current pumping capacity, and permitted withdrawal limits.	Annual process water use volume, 7,876,000 gal; based on 24 hr/d, 365 d/yr operations. Less than historic high usage, current pumping capacity, and permitted withdrawal limits.	Annual process water use volume, 5,700,000 gal; based on 12 hr/d, 276 d/yr operations. Less than historic high usage, current pumping capacity, and permitted withdrawal limits.	Annual process water use volume, 1,300,000 gal; based on 12 hr/d, 276 d/yr operations. Less than historic high usage, current pumping capacity, and permitted withdrawal limits.	No changes to existing water supply and use. Upgrades to system would not be implemented.
Electrical power	Uses 29 GWh/yr. System upgrades including a new substation would be installed. No adverse impact to power availability.	Uses 25.2 GWh/yr. System upgrades including a new substation would be installed. No adverse impact to power availability.	Uses 36 GWh/yr. System upgrades including a new substation would be installed. No adverse impact to power availability.	Uses 60 GWh/yr. System upgrades including a new substation would be installed. No adverse impact to power availability.	No change in electrical power supply or use.
Natural gas	Primary fuel for operations. Average use 391,500,000 ft^3/yr can be met by supplier and supported by PCD main line. No significant impact.	Primary fuel for operations. Average use 200,000,000 ft^3/yr because includes fewer incinerators than baseline. No significant impact.	Average use 94,000,000 ft^3/yr for steam boilers. No significant impact.	Average use 149,000,000 ft^3/yr for steam boilers and heat for SCWO. No significant impact.	No changes to natural gas supply or use.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action Alternative
Waste management	Energetics destroyed on-site in DFS. Ash (1 ton) and liquid brines (16 million gal) shipped to off-site TSDF. Sewage treated; effluent to evaporation lagoons.	Energetics shipped off-site or destroyed on-site. Ash (1 ton) and liquid brines (14.45 million gal) shipped to off-site TSDF. Sewage treated; effluent to evaporation lagoons.	Energetics would be neutralized on-site. Brine salts (4750 tons), biomass (2660 tons) shipped to off-site TSDF. Process liquids would be recycled. Sewage treated; effluent to evaporation lagoons.	Energetics would be neutralized on-site. Brine salts (5060 tons) shipped to off-site TSDF. Process liquids would be recycled. Sewage treated; effluent to evaporation lagoons.	Continued degradation of munitions over time. Estimated 7.5 tons/yr solid and 2.5 tons/yr liquid hazardous wastes would be produced and stored on-site indefinitely until an off-site TSDF is identified.
Air quality-criteria pollutants	JACADS tests show low level emissions of NO_2, SO_2, CO, PM-10, but negligible impacts and no exceedances of NAAQS expected.	Emissions equal to or less than baseline incineration. Negligible impacts and no exceedances of NAAQS expected.	Estimate lower emissions than from agent incineration process; resulting from boilers and generators only.	Estimate lower emissions than from agent incineration process; resulting from boilers and generators only.	No changes in emissions of criteria pollutants.
Air quality-hazardous and toxic substances	Based on JACADS burns and process modifications, no significant impacts and no exceedances of limits expected.	Impacts similar to baseline incineration.	Estimate 2% or less of allowable limits, thus small impacts.	Estimate 2% or less of allowable limits, thus small impacts.	Possibility of an accident with potentially severe impacts remains with continued storage.
Human health	No exceedances of emissions standards or exposure levels expected; site-specific health risk assessment and food crop monitoring will be conducted to ensure no adverse health effects.	No exceedances of emissions standards or exposure levels expected; site-specific health risk assessment and food crop monitoring will be conducted to ensure no adverse health effects.	No exceedances of standards or levels expected. Estimated lifetime cancer risk less than 1 in 1 million; estimated mustard exposure, less than 1% of allowable level.	No exceedances of standards or levels expected. Estimated lifetime cancer risk less than 1 in 1 million; estimated mustard exposure, less than 1% of allowable level.	Small, but well understood risks to workers continue, but no health impacts likely.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action Alternative
Noise	Less than 40 dB(A) at nearest residence. No impacts expected.	Less than 40 dB(A) at nearest residence. No impacts expected.	Less than 40 dB(A) at nearest residence. No impacts expected.	Less than 40 dB(A) at nearest residence. No impacts expected.	Sound levels remain at present low levels.
Visual impacts	No significant visual impact.	No significant visual impact.	No significant visual impact.	No significant visual impact.	No change in visual character of PCD.
Geology and soils	No disturbance or contamination under routine operations.	No disturbance or contamination under routine operations.	No disturbance or contamination under routine operations.	No disturbance or contamination under routine operations.	Continued absence of impacts to soils.
Groundwater	Greatest process water requirement 29.9 acre-ft/yr. Possible temporary decline in water table and increase in natural selenium and hardness. Less than historical depot use.	Estimated process water requirement 24.2 acre-ft/yr. Possible temporary decline in water table and increase in natural selenium and hardness. Less than historical depot use.	Estimated total process water requirement 17.5 acre-ft/yr. Possible temporary decline in water table and increase in natural selenium and hardness. Less than historical depot use.	Least potential impact on water table and water quality. Estimated process water requirement 4.0 acre-ft/yr. Possible temporary decline in water table and increase in natural selenium and hardness. Less than historical depot use.	Groundwater use would remain the same.
Surface water	Greatest groundwater withdrawal, potential for temporary low to moderate impacts on flow in on-site ponds, steams, and wetlands.	Due to groundwater withdrawal, some potential for low to moderate impacts on flow in on-site ponds, steams, and wetlands.	Due to groundwater withdrawal, some potential for temporary low to moderate impacts on flow in on-site ponds, steams, and wetlands.	Least groundwater withdrawal, potential for low to moderate but temporary impacts on flow in on-site ponds. steams, and wetlands.	Possibility for impacts from a storage accident would remain.
Terrestrial Ecology	No significant impacts expected. A site-specific ecological risk assessment will be conducted.	No significant impacts expected. A site-specific ecological risk assessment will be conducted.	No significant impacts expected during routine operations.	No significant impacts expected during routine operations.	No change from current low-level impacts of continued storage.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action Alternative
Aquatic Ecology	Greatest groundwater withdrawal, potential for temporary low to moderate impacts to on-site aquatic habitats. A site-specific ecological risk assessment will be conducted.	Due to groundwater withdrawal, alternatives, some potential for temporary low to moderate impacts to on-site aquatic habitats. A site-specific ecological risk assessment will be conducted.	Due to groundwater withdrawal, potential for temporary low to moderate impacts to on-site aquatic habitats.	Least groundwater withdrawal among alternatives, potential for temporary low to moderate impacts to on-site aquatic habitats.	Normal monitoring and maintenance would not affect aquatic habitats.
Protected Species	Greatest groundwater withdrawal, potential for temporary low to moderate impacts on the plains minnow, and the northern and plains leopard frogs residing in on-site surface waters and wetland. A site-specific ecological risk assessment will be conducted.	Due to groundwater withdrawal, some potential for temporary, low to moderate impacts on the plains minnow, and the northern and plains leopard frogs residing in on-site surface waters and wetlands. A site-specific ecological risk assessment will be conducted.	Due to groundwater withdrawal, potential for temporary low to moderate impacts on the plains minnow, and the northern and plains leopard frogs residing in on-site surface waters and wetlands.	Least amount of groundwater withdrawal among alternatives; potential for temporary low to moderate impacts on the plains minnow, and the northern and plains leopard frogs residing in on-site surface waters and wetlands.	Normal monitoring and maintenance would not affect on-site wetland and aquatic protected species.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action Alternative
Wetlands	Greatest groundwater withdrawal, potential for temporary low to moderate impacts on on-site wetland habitat and communities. A site-specific ecological risk assessment will be conducted.	Due to groundwater withdrawal, potential for temporary low to moderate impacts on on-site wetland habitat and communities. A site-specific ecological risk assessment will be conducted.	Due to groundwater withdrawal, potential for temporary low to moderate impacts on on-site wetland habitat and communities.	Least amount of groundwater withdrawal among alternatives; potential for temporary low to moderate impacts on on-site wetland habitat and communities.	Normal monitoring and maintenance would not affect on-site wetland habitat and communities.
Archaeological cultural and historic resources	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts to resources.
Socioeconomic resources	No significant impacts to public services, housing, or infrastructure expected. Direct and indirect employment up to 983; inmigration up to 508; income $29.6 million.	No significant impacts to public services, housing, or infrastructure expected. Direct and indirect employment up to 826; inmigration up to 427; income up to $24.9 million.	No significant impacts to public services, housing, or infrastructure expected. Direct and indirect employment up to 1171; inmigration up to 754; income $30.2 million.	No significant impacts to public services, housing, or infrastructure expected. Direct and indirect employment up to 1171; inmigration up to 754; income $30.2 million.	No change in socioeconomic effects of PCD. The benefits of the reuse plan would not be realized.
Environmental justice	No unique and/or adverse effects on minority or low income populations are expected.	No unique and/or adverse effects on minority or low income populations are expected.	No unique and/or adverse effects on minority or low income populations are expected.	No unique and/or adverse effects on minority or low income populations are expected.	No project-related impacts would occur.

Table 3.2 (continued)

Potentially Affected Resource	Baseline Incineration	Modified Incineration	Neutralization with Biotreatment	Neutralization with SCWO	No Action
Potential Impacts from Hypothetical Accidents					
All resource categories	Am earthquake affecting the destruction facility could produce lethal airborne concentrations up to 5 miles (9 km) downwind. Potential off-post fatalities would be 2 people. Deposition of mustard agent could contaminate off-post land areas, crops, habitat, surface waters, and cultural resources.	Impacts would be similar to those of Baseline Incineration.	Aircrash into destruction facility could produce lethal airborne concentrations up to 5 miles (9 km) downwind. Potential off-post fatalities would be 2 people. Deposition of mustard agent could contaminate off-post land areas, crops, habitat, surface waters, and cultural resources.	Impacts would be similar to those of Neutralization with Biotreatment.	Aircrash into a storage igloo could produce lethal airborne concentrations up to 19 miles) downwind. Potential off-post fatalities could be up to 290. Deposition of mustard agent could contaminate off-post land areas, crops, habitat, surface waters, and cultural resources.

4. EXISTING CONDITIONS AND ENVIRONMENTAL IMPACTS

In this section the impacts of baseline incineration, modified incineration, neutralization followed by SCWO, and neutralization followed by biotreatment are analyzed and compared to the extent that data and information are available. The information presented concerning the neutralization alternatives is based on on-going studies as provided by the U.S. Army ACWA Program. New information will continue to be evaluated as it becomes available from ACWA.

4.1 POTENTIAL SITES AND FACILITY LOCATIONS FOR CHEMICAL MUNITIONS ACTIVITIES AT PUEBLO

PCD is located in southeastern Colorado, approximately 14 miles east of the center of the City of Pueblo in Pueblo County about 1 mile north of the Arkansas River (Fig. 2.1). The installation encompasses approximately 23,000 acres and includes a variety of buildings, structures, and undeveloped areas.

Most of the land areas surrounding PCD are undeveloped ranchland used for grazing, although some areas to the south are zoned for light commercial and residential use. The Federal Railroad Administration’s Transportation Technology Center (TTC) is adjacent to PCD’s northern boundary.

All of PCD’s missions, other than chemical weapon storage and demilitarization, were realigned pursuant to the Base Realignment and Closure legislation of 1988. Notwithstanding the limitations in the authority of that legislation, actual closure of the installation is anticipated after completion of the chemical demilitarization mission.

As discussed in Section 2 of this FEIS, it is assumed that any munitions destruction facility would be constructed within the vicinity of Munitions Storage Area A where the chemical weapons are stored. The area considered appropriate for construction of a destruction facility was subdivided into three smaller areas labeled A, B, and C (Fig. 4.1). Three potential corridors for constructing supply lines for electric power, water, and natural gas were identified and labeled Corridors 1, 2, and 3 (Fig. 4.1). Also, three potential access roads to the destruction site were identified and labeled Running Routes 1, 2, and 3 (Fig. 4.1). Regardless of which corridor and running route are selected, they could serve any of the three destruction facility areas. Because of these delineations, descriptions of the affected environment at PCD focus on Areas A, B, and C, Corridors 1, 2, and 3, and Running Routes 1, 2, and 3. However, information about other parts of PCD is presented as needed to support the assessment of potential impacts from constructing and operating a chemical munitions destruction facility.

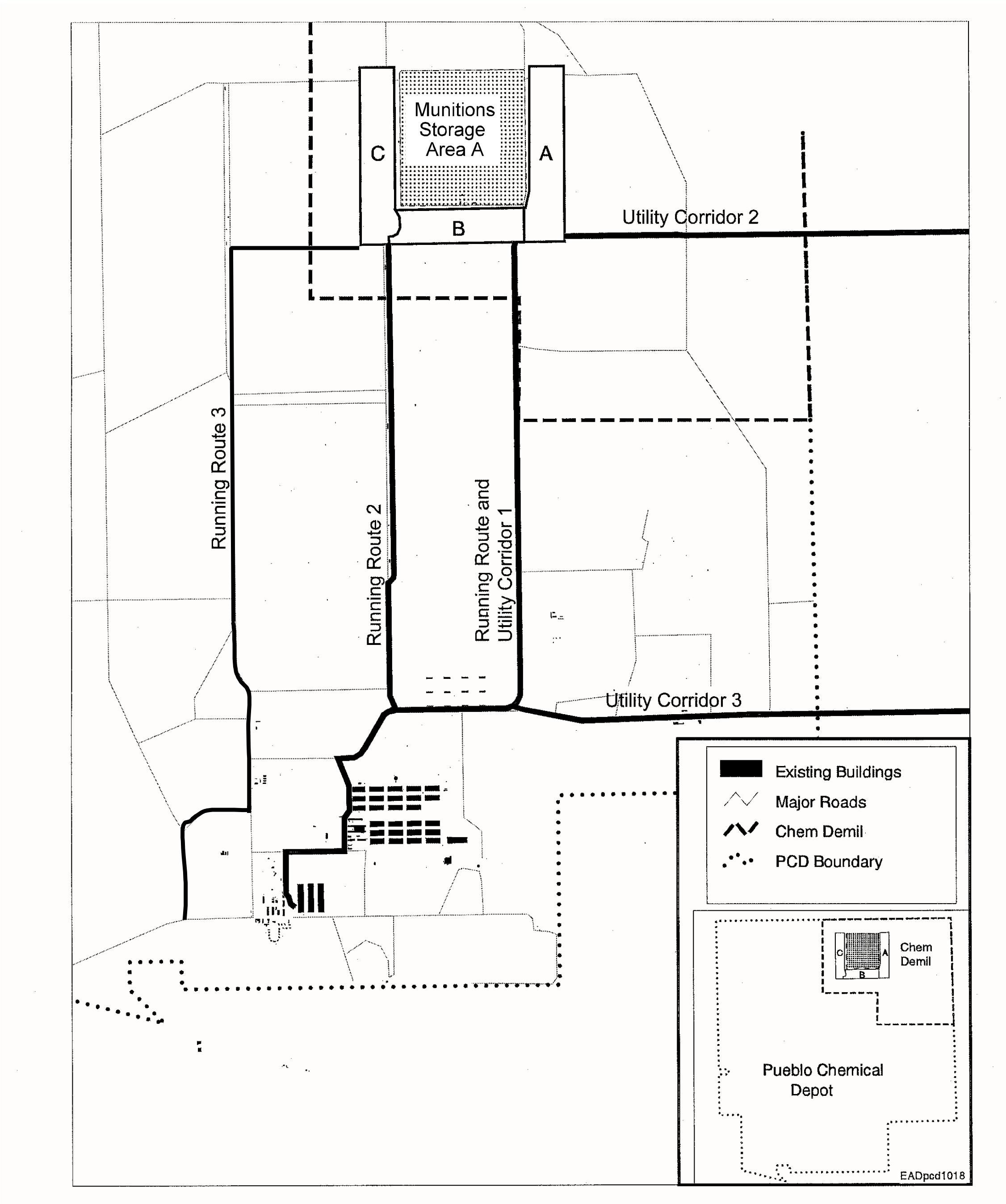


Fig. 4.1. Pueblo Chemical Depot showing potential utility corridors.

4.2 LAND USE

4.2.1 Site History and Use

Military occupation of the Pueblo Ordnance Depot (POD), now referred to as PCD, began in 1943.[1] POD was one of 16 new ordnance depots constructed in 1942 for a World War II mobilization expansion program. The depot's primary function was the storage and shipment of ammunition, but it was also used as a medical supply depot.

In the early 1950s, POD was a distribution center for military supplies for 78 installations in a 9-state region from the Dakotas to Arizona. During this time, POD expanded much of its storage capacity and facilities to accommodate a growing workforce. Also during this time, POD began storing chemical munitions, such as distilled mustard munitions, that were being produced at Rocky Mountain Arsenal north of Denver, Colorado, and Redstone Arsenal west of Huntsville, Alabama. Originally the chemical munitions were stored in the igloos in C-Block, but they were later moved to Munitions Storage Area A in the northeastern portion of POD. Nuclear weapons, such as atomic cannon ammunition, were stored in J-Block from 1954 until 1965.

Another expansion occurred in the late 1950s with the addition of a new function for the depot: missile storage and maintenance. By 1961, POD had become the "nation's prime depot for maintenance, rebuilding, and storage of the Army's three major missiles (the Redstone, Pershing, and Sergeant) and their systems" (Simmons and Simmons 1998). Hawk and LaCrosse missiles were also serviced at POD.

POD was renamed Pueblo Army Depot (PAD) in 1962. Depot closures in South Dakota and Nebraska in the mid-1960s led to yet another expansion of PAD, making it one of the largest U.S. Army Materiel Command depots in the nation. Activities continued to diversify. The facility was used to maintain and rebuild vehicles and equipment and to store, maintain, and distribute materials for fixed and floating bridges. It also served as a repository for U.S. Army historical properties.

A phase-down of PAD was announced in 1974 in response to the end of the Vietnam War. Many activities were transferred to other facilities. PAD continued to act as a storage supply depot for ammunition and supplies and as a maintenance facility for the Pershing missile system. In 1976, PAD became a satellite facility to Tooele Army Depot and was renamed Pueblo Depot Activity (PDA).

The main mission of the depot today is the storage of a portion of the nation's chemical weapons stockpile. In 1996, PDA was given its current name, Pueblo Chemical Depot (PCD), to reflect its primary mission.

4.2.2 Current and Planned On-Post Land Use

Existing on-post land use at PCD is primarily industrial and administrative, with some limited residential and recreational development to support personnel housed at the installation (Fig. 4.2).

---

[1]The military history presented here is summarized from Front Range Research Associates, Inc. (Simmons and Simmons 1998).

Because of DOD's changing requirements, PCD was recommended for realignment in the 1988 Base Realignment and Closure legislation. An EIS was completed by the Army for realignment of PCD in 1991. In response to the recommended realignment, a reuse development plan for PCD was adopted in 1995 (EDAW et al. 1994) and updated in 2000 (PDADA 2000a). The reuse development plan considered 14 different uses for PCD, maintaining the allocation of more than 5200 acres (approximately 23% of PCD) in the northeastern portion of the installation for chemical demilitarization (Fig. 4.3).

The plan designates 8455 acres (approximately 37% of PCD) as "industrial," and specifically identifies "large warehousing and distribution facilities" as probable uses because "Pueblo's geographic location and moderate climate are conducive to such uses." The plan also states that "residential expansion is envisioned" for PCD [approximately 210 acres to accommodate 80 to 150 new dwelling units, open space, buffer areas, and new septic systems if needed], and allocates 5 acres for a recreational facility adjacent to the proposed residential area. Lastly, the plan designates in perpetuity 14,154 acres (approximately 62% of PCD) as a wildlife management area with open space, trails and public access, wildlife habitat, ecological and biological study sites, and specific recreation uses (PDADA 2000a).

4.2.3 Current and Planned Off-Post Land Use

As is true for much of Pueblo County, the primary off-post land use in the vicinity of PCD is pastureland. In 1997, Pueblo County contained 822,584 acres of farmland, the vast majority of which (732,658 acres) was used for pastureland, with only 89,926 acres used for cropland (USDA 1999b). The market value of agricultural products sold in Pueblo County in 1997 was approximately $33.6 million; of this total, approximately $19.4 million was for livestock and $14.2 million was for crops (USDA 1999b).

Various public and private interests own the land surrounding PCD (Fig. 4.4). The state of Colorado owns most of the land north of the installation, as well as parcels to the east and west of PCD. Included in this state land is the site of the TTC, a facility for testing rail engines and cars which is located north of PCD's northern boundary. The federal government owns several tracts east of PCD; these are managed by the Bureau of Land Management (BLM). Remaining land in the vicinity of PCD is privately owned, including a private ranch adjacent to PCD boundary north of G-Block.

Land use near PCD is mainly agricultural and zoned Agricultural One (A-1) by the Pueblo Board of County Commissioners. With the exception of the TTC, the state lands depicted in Fig 4.4 are leased for grazing. The State Board of Land Commissioners maintains a multiple-use policy for land owned by the state; although the state land in the vicinity of PCD could be managed for wildlife and recreational purposes, these uses remain unexplored. The BLM land in the vicinity of the installation is also leased for grazing. Because these BLM tracts are small and noncontiguous, they are difficult to manage and are being studied to determine their future disposition. Most of the private land near PCD is used for grazing.

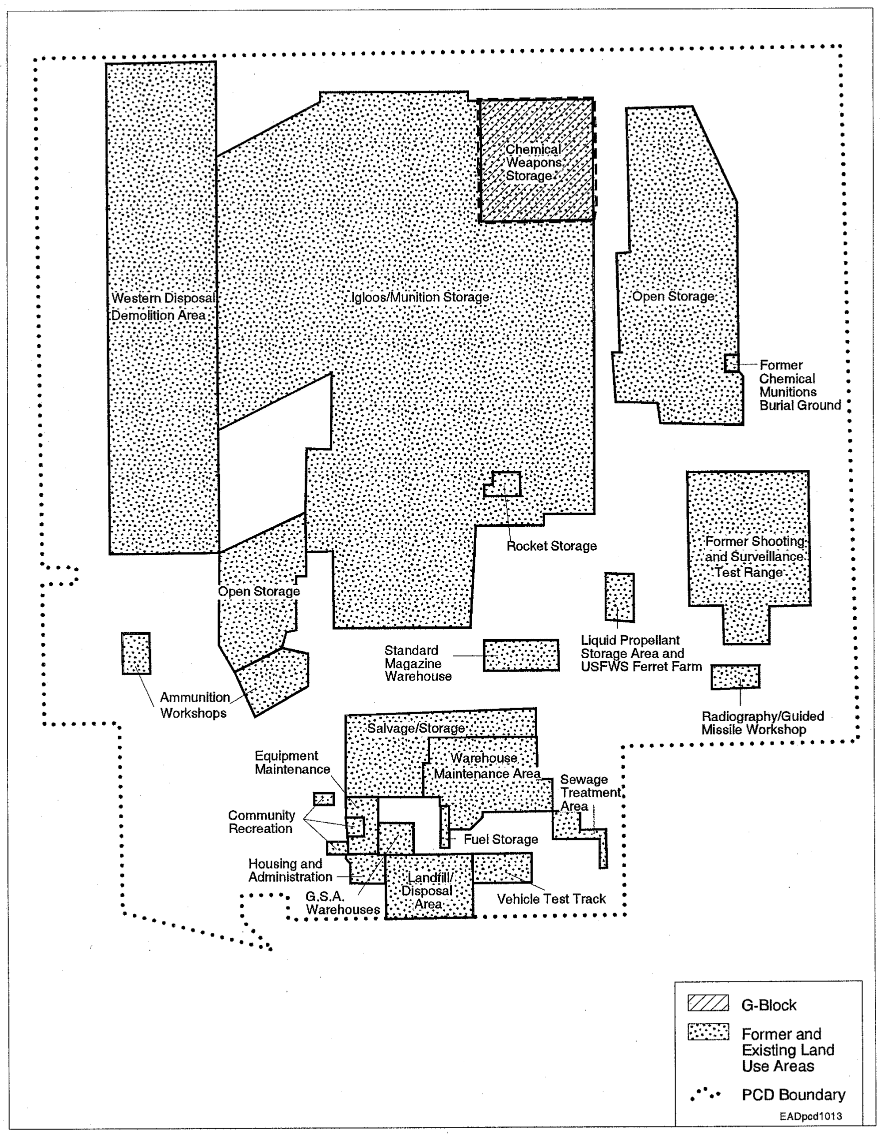


Figure 4.2. Existing Land Use at Pueblo Chemical Depot. ***Source:*** EDAW et al., 1994**.**

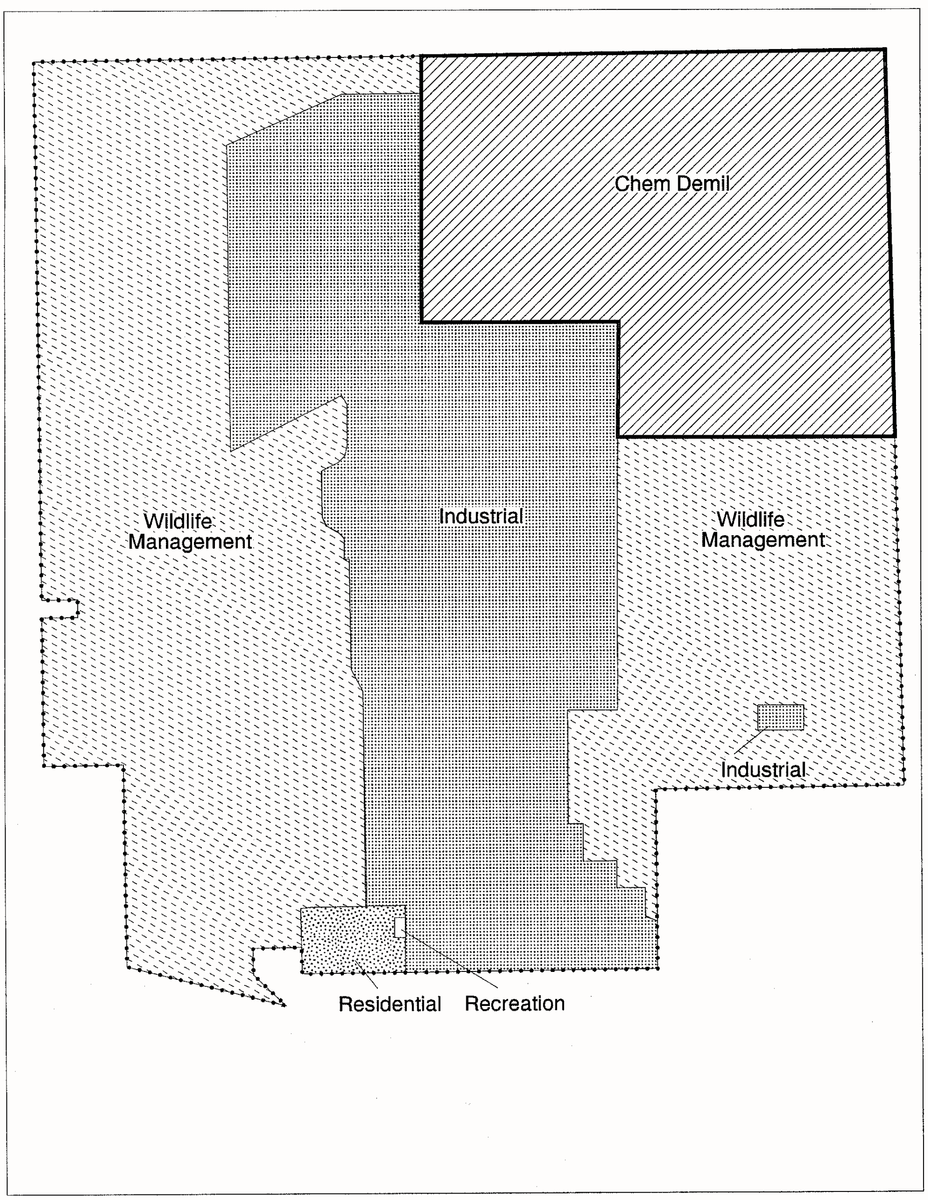


Fig. 4.3. Land use proposed in Pueblo Chemical Depot reuse development plan.
Source: EDAW et al., 1994.

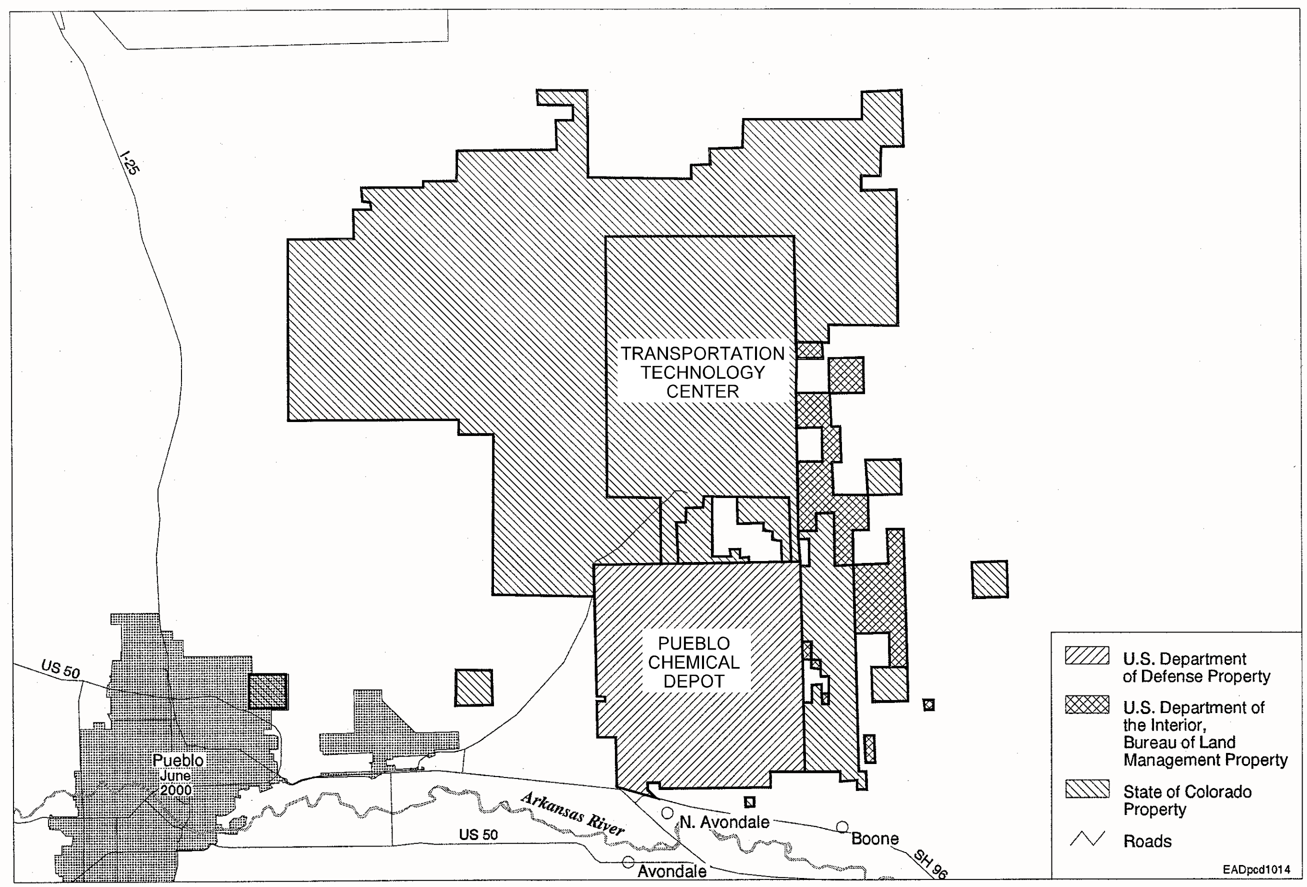


Fig. 4.4. Land ownership near Pueblo Chemical Depot. *Source:* City of Pueblo Public Works Dept.; www.ci.pueblo.co.us/citymap.html: EDAW et al., 1994.

4.2.4 Impacts of Destruction on Land Use

The impacts on land use of constructing and operating a destruction facility involving either incineration or neutralization technologies would be similar.

On-Post Land Use. Construction of either an incineration or neutralization facility would not have significant impacts on on-post land use because land disturbance would be limited to a relatively small area (approximately 20 acres) for the facility footprint, with the potential for up to 85 acres total land disturbance] within the larger area of PCD that has been reserved for chemical demilitarization activities (5200 acres). Construction activities would be compatible with existing land uses and with the land uses proposed for the northeastern portion of PCD in the *Reuse Development Plan Update*. Using the areas in proximity to G Block would not be in conflict with the plan “provided wildlife will have access to the area and wildlife management personnel will be allowed to implement revegetation and erosion control practices in this upper portion of the buffer area” (PDADA 2000a).

Routine operation of a destruction facility would not have significant impacts to on-post land use because operational activities would be confined to the area of PCD that has been reserved for chemical demilitarization. Further, routine operations would be compatible with the land uses proposed for the northeastern portion of PCD in the 2000 *Reuse Development Plan Update* (PDADA 2000a).

Off-Post Land Use. Construction of either an incineration or a neutralization destruction facility would not affect off-post land use around PCD because most construction activities would be contained within PCD. Routine operation of the facility would not have significant impacts to off-post land use because operational activities would be confined to PCD. Under any of the destruction options, off-post construction of utility corridors to the site would not have significant impacts because it would occur primarily on lands used for grazing.

4.2.5 Impacts of No Action

There would be no land use impacts related to chemical agent destruction facilities under the no action alternative. The potential would remain, however, for on-post and off-post land use impacts as a result of an accidental release during continued on-site storage (see Sect. 4.22).

4.2.6 Cumulative Impacts

On-Post Land Use. Past and present land use at PCD suggests that industrial uses, particularly storage and distribution facilities, will continue to be important on-post land uses, with some administrative, residential, recreational, and wildlife management activities also occurring. Construction and routine operation of facilities for chemical agent destruction, whether they be incineration facilities or neutralization facilities, would not contribute to cumulative impacts on the land uses proposed in the *Reuse Development Plan Update* (PDADA 2000a) as long as they are sited within the area of PCD reserved for such activities.

Off-Post Land Use. Past and present land use around PCD suggests that agricultural uses, particularly livestock grazing, will continue to be the primary types of land use, with some new industrial uses (such as the TTC) possible. Construction and routine operation of facilities for chemical agent destruction, whether they be incineration facilities or neutralization facilities, would not contribute to cumulative impacts to off-post land uses because they would be confined primarily to PCD.

4.3 WATER SUPPLY AND USE

4.3.1 Current Water Supply and Use

PCD currently obtains its water from a system of on-post wells supplied by an alluvial aquifer (see Sect. 4.13). These wells have a pumping capacity of 79,891,200 gal/year. Approximately 1,423,500 gal/year are consumed by current PCD activities (Rust 1997). Thus, PCD has excess pumping capacity of approximately 78,467,700 gal/year.

The PCD water distribution system was installed in 1942. While sections of the original water lines have been replaced, much of the system may need to be upgraded (PDADA 2000b; Pueblo County 1999b). The exception is the 10-in. main water line from the PCD water tank to Munitions Storage Area A (Pueblo County 1999b).

4.3.2 Destruction System Requirements

Process water requirements for baseline incineration would average about 9,729,000 gal/year (Venkatadri 2001) (Table 4.1). Modified incineration would average about 7,876,000 gal/year (Venkatadri 2001). Neutralization with SCWO or biotreatment would require approximately 1,300,000 and 5,700,000 gal/year respectively (Personal communication from Jon Ware, ACWA to Penny Robitaille, PMCD, December 18,2001). The incineration volumes are based on operating 6 days per week, 24 hours per day for baseline and 7 days per week 24 hours per day for modified (Black 2002). The neutralization volumes are based on 6 days per week, 12 hours per day (ANL 2001b). Potable water use for all alternatives would require an average of about 6,400,000 gal/year (U.S. Army 2000b; ANL 2001b).

4.3.3 Impacts on Water Supply and Use

4.3.3.1 Impacts of baseline incineration

On-Post Impacts. During construction, water would be used for preparing concrete aggregate and other similar construction materials and for rinsing equipment, structures, and materials. The quantities of water needed for these activities cannot be estimated precisely, but it is not likely that they would exceed the existing pumping capacity of the PCD water system. Although facility construction itself would not have significant impacts on the water distribution system, it would include the installation of a new water line (from the existing 10-in. main line to the destruction facility). Installation of the new line is not likely to have significant impacts because it would occur in previously disturbed areas of PCD.

During operation of the baseline facility, water would be required to support the destruction process and fire-fighting and personnel needs. Table 4.1 provides estimates of average annual water demand for these operational uses. The amounts of water estimated for average annual consumption are far less than historic high usage and existing capacity of the

PCD water distribution system. The potential impacts of facility operations on the alluvial aquifer are discussed in Sect. 4.13.4.

Table 4.1. Average annual water requirements for operating chemical agent destruction facilities at the Pueblo Chemical Depot (gallons/year)

	Baseline Incineration	Modified Incineration	Neutralization/ SCWO	Neutralization/ Biotreatment
Process Water				
Average	9,729,000[a]	7,876,000[b]	1,300,000[c]	5,700,000[c]
Lifetime	52,700,000	19,690,000	3,000,000	17,400,000
Potable Water				
Average	6,400,000	6,400,000	6,400,000	6,400,000
Lifetime	19,200,000	12,800,000	19,200,000	19,200,000

[a]6 days per week, 24 hours per day (Black 2002).
[b]7 days per week, 24 hours per day (Black 2002).
[c]6 days per week, 12 hours per day (ANL 2001b).

Off-Post Impacts. The quantities of water required for construction activities would be relatively small and off-site water supply and use would not likely be affected (Sect. 4.13.4).

Water consumption at PCD would increase during facility operations because additional process and potable water would be required. The existing system of wells tapping the alluvial aquifer would be used to obtain this additional water. The historic demand for groundwater at PCD has decreased in recent years due to workload reductions, so the total demand for groundwater at PCD during destruction facility operations would not be expected to exceed the maximum pumping capacity of the existing system.

Current demand for groundwater at PCD is met by pumping the alluvial aquifer three days per week. Although the spacing between water-supply wells has been increased, localized drawdown continues to cause some water quality problems. Continuous pumping in the future to supply the destruction facility would intensify this problem, as discussed in Sect. 4.13.4.

4.3.3.2 Impacts of modified incineration

On-Post Impacts. For on-post water supply and consumption, the impacts of constructing a modified incineration facility would be similar to those of constructing a baseline facility (Sect. 4.3.3.1) (U.S. Army 2000b). During operations, the process water requirement for modified incineration would be less than that for baseline incineration (Table 4.1). The potential impacts of modified facility operations on the alluvial aquifer are discussed in Sect. 4.14.4.

Off-Post Impacts. During operations, the impacts of modified incineration water consumption would be reduced from those of baseline incineration (Sect. 4.3.3.1). Thus, off-site water use would not likely be affected. The potential for impacts of modified facility operations to off-site water quality are discussed further in Sect. 4.13.4.

4.3.3.3 Impacts of neutralization alternatives

On-Post Impacts. Impacts to on-post water supply and use would not be significant during the construction and operation of facilities for neutralization with SCWO or biotreatment because PCD's existing water supply wells would be capable of meeting the increased demand. The demand for process water associated with neutralization by SCWO or biotreatment would be less than that of baseline or modified incineration (Table 4.1).

Off-Post Impacts. Impacts to off-post water supply are not expected to be significant during the construction and operation of facilities for neutralization with SCWO or biotreatment.

4.3.4 Impacts of No Action

Under the no action alternative, there would be no project-related changes to on-post or off-post water supply or use. Upgrades to the existing PCD water distribution system that would be implemented under any of the destruction options would not be implemented under the no action alternative.

4.3.5 Cumulative Impacts

On-Post Impacts. For on-post water supply and consumption, constructing and operating a chemical destruction facility would have the cumulative impact of diverting water from other potential on-post uses. However, the construction and operation of a chemical destruction facility could have positive impacts for reuse if the upgrades proposed for the existing water system would be implemented on a scale that would improve service to the entire PCD.

Off-Post Impacts. For off-post water supply, constructing and operating a chemical destruction facility could have the cumulative impact of diverting water from other potential off-post uses in case of a severe shortage. This is an issue of concern given existing concerns over the availability of water in the western United States and the importance of agricultural production in the area surrounding PCD. However, because the quantities of water required to construct and operate the chemical destruction facility are relatively small, there would be negligible impacts to groundwater flow, and the facilities' contributions to cumulative off-site impacts are not expected to be significant. Potential cumulative impacts to water availability and quality are discussed in Sect. 4.13.4.

4.4 ELECTRICAL POWER SUPPLY

4.4.1 Current Electrical Power Supply

The primary provider of electrical power to PCD is the West Plains Energy Corporation, with allotments to PCD ranging up to 1.6 million kWh. PCD typically uses most or all of this allotment, so supplemental contracts with West Plains Energy Corporation and other providers have been established to meet additional power needs. Southern Colorado Power Company delivers the power to PCD through an existing 69-kV line.

4.4.2 Destruction System Requirements

Operating a baseline incineration facility would require 29 GWh/year of electricity for 5.4 years, while operating a modified incineration facility would require 25.2 GWh/year for 2.5 years (Venkatadri 2001). Electricity requirements for operating a neutralization facility with either SCWO (60 GWh/year) or biotreatment (36 GWh/year) would be higher (ANL 2001b).

4.4.3 Impacts on Electrical Power Supply

4.4.3.1 Impacts of baseline incineration

During construction, electrical power would be used for a variety of activities. The quantity of electrical power needed for construction cannot be estimated precisely, but it is expected that it would not exceed the existing capacity of the electrical distribution system.

Although destruction facility construction would not have significant impacts on the electrical system, it would include the construction of a new electrical substation and related facilities that would be required for destruction facility operations. The new substation, which would be constructed within PCD boundaries near the site of the destruction facilities, would also require the construction of a new 115-kV overhead power line. Buried power lines would be installed to connect the new substation with the destruction facilities.

4.4.3.2 Impacts of modified incineration

The impacts of destruction facility construction on electrical power supply would be the same for modified incineration as for baseline incineration. However, the impacts of destruction facility operation would be slightly smaller for modified incineration (25.2 GWh/year) because it would require less electrical power than baseline (29 GWh/year) (U.S. Army 2000b).

4.4.3.3 Impacts of neutralization alternatives

Impacts to the electrical power supply would not be significant during the construction and operation of a facility for neutralization with SCWO or biotreatment, although both neutralization alternatives would require more electrical power than either of the incineration alternatives. Electrical system upgrades, including a new substation, would be installed by the Army as part of the proposed action. This upgraded system would be designed to handle the electrical power needs of operating a neutralization facility with SCWO (60 GWh/year) or biotreatment (36 GWh/year) (ANL 2001b).

4.4.4 Impacts of No Action

Under the no action alternative, there would be no project-related changes to the existing electrical power supply. Upgrades to the PCD electrical distribution system that would be implemented under any of the destruction options would not be implemented under the no action alternative. This lack of upgrades could adversely affect PCD redevelopment efforts under the *Reuse Development Plan Update* (PDADA 2000a).

4.4.5 Cumulative Impacts

Constructing and operating a chemical destruction facility could have the cumulative impact of diverting electrical power from other potential on-post uses in the future. However, positive cumulative impacts could result if the upgrades proposed for the existing electrical distribution system would be implemented on a scale that would improve service to the entire PCD.

4.5 NATURAL GAS SUPPLY

4.5.1 Current Natural Gas Supply

Natural gas, which is supplied to PCD by Excel Energy, is currently used only in buildings located in the housing, administrative, and warehouse areas. The main gas line at PCD was installed in 1998 and sized to meet the requirements of chemical demilitarization.

4.5.2 Destruction System Requirements

The natural gas requirements of any of the destruction alternatives would be met by the current supplier. Baseline incineration would have the highest average requirements, averaging 391,500,000 ft^3/year for 5.4 years (Table 4.2) (Venkatadri 2001). Modified incineration would have the next highest (200,000,000 ft^3/year) (Venkatadri 2001), followed by neutralization with SCWO (149,000,000 ft^3/year), and neutralization with biotreatment (94,000,000 ft^3/year) (ANL 2001b).

Table 4.2. Average annual natural gas requirements for operating chemical agent destruction facilities at the Pueblo Chemical Depot (ft^3/year)

Baseline Incineration[a]	Modified Incineration[b]	Neutralization/[c] SCWO	Neutralization/[c] Biotreatment
391,500,000	200,000,000	149,000,000	94,000,000

[a]6 days per week, 24 hours per day (Black 2002).
[a]7 days per week, 24 hours per day (Black 2002).
[c]6 days per week, 12 hours per day (ANL 2001b).

4.5.3 Impacts on Natural Gas Supply

4.5.3.1 Impacts of baseline incineration

Construction of the baseline incineration facility would not require natural gas. However, construction would include the installation of a new natural gas pipeline extending from the existing main line at the Gas Regulator Station located at the intersection of PCD's 11th Street and 5th Avenue. It is assumed that the new pipeline would be installed in Corridor 1, 2, or 3 (Fig. 4.1). Installation of this new pipeline is not likely to have significant impacts because it would occur in a previously disturbed area of the PCD.

Natural gas would be the primary fuel for operating the baseline incineration facility, including the boilers for process steam and building heat. Table 4.2 provides estimates of average annual demand for natural gas during operations. This new demand for natural gas could be met by the existing supplier, especially since the PCD main line was sized to meet the additional needs of a chemical demilitarization facility.

4.5.3.2 Impacts of modified incineration

The impacts of destruction facility construction on the natural gas supply would be the same for modified incineration as for baseline incineration. However, the impacts of destruction facility operation would be smaller for modified incineration because it would require nearly 50% less natural gas than baseline incineration (Venkatadri 2001).

4.5.3.3 Neutralization system requirements

Impacts to the natural gas supply system are not expected to be significant during the construction and operation of facilities for neutralization with SCWO or biotreatment because the existing gas line at PCD was installed to meet the requirements of baseline incineration, which would be larger than those of neutralization (Table 4.2) (ANL 2001b).

4.5.4 Impacts of No Action

Under the no action alternative, there would be no project-related changes to the existing natural gas supply.

4.5.5 Cumulative Impacts

Constructing and operating chemical agent destruction facilities could have the cumulative impact of temporarily diverting a portion of the natural gas supply from other potential on-post uses in the future.

4.6 WASTE MANAGEMENT AND FACILITIES

Mustard agents (H, HD, and HT) are listed wastes according to Colorado Department of Public Health and Environment Regulations Part 261; H and HD are listed waste P909 and HT is listed waste P910. [Mustard gas is listed as a hazardous constituent in *6 Code of Colorado Regulations (CCR) 1007-3, Section 261.33.*]. Waste chemical weapons using or containing any of the mustard agents are listed wastes K901 under 6 CCR 1007, Section 261.32. Also the same section of CCR declares that residues resulting from treating waste chemical weapons are listed wastes K901. Additionally any soil, water, debris, or containers contaminated through contact with chemical weapons hazardous waste is listed waste P902. Colorado statutes address hazardous waste at Article 15. Hazardous Waste, 25-15-101 to 25-15-515 and Article 16. Hazardous Waste Sites, 25-16-101 to 25-16-311. Additionally any solid waste residuals from the destruction processing are listed hazardous wastes under 6 *CCR* 1007, Section 261.3(c)(2)(i). The listed wastes retain the hazardous classification regardless of their hazardous characteristics unless they are delisted by the state of Colorado.

The environmental waste management consequences from construction, and operation of a facility to destroy the chemical munitions stored at PCD are addressed in this section. Following a description of current waste management practices and facilities, the potential impacts of two incineration and two chemical neutralization technologies for chemical agent destruction, as well as the impacts of no action, are assessed and compared.

Impacts Summary. Construction of a chemical munitions destruction facility using any of the four technology alternatives addressed in this FEIS would generate both solid and liquid nonhazardous wastes, as well as small amounts of solid and liquid hazardous wastes (for the neutralization technologies, the liquid hazardous waste would occur only after the final processing run). No significant impacts to waste management are expected as a result of construction of a destruction facility. Wastes would be collected and disposed of in accordance with U.S. Army, state, and federal regulations. Any wastes that are listed as hazardous in the RCRA regulations would be stored and disposed of as prescribed by EPA and applicable state and local regulations. All wastes resulting from chemical agent processing including munition bodies, brine liquids and salts, and ash would be listed hazardous wastes by the State of Colorado.

The primary process liquid effluent from operations of the incineration alternatives would be brine liquids generated from the PAS equipment. The brine would be shipped off-site to a permitted TSDF in accordance with applicable regulations. The major solids that would be generated by the incineration alternatives would be metal parts/ash that exit the metal parts furnace and the energetics treatment furnace. Additionally, waste charcoal would be generated from filters. The brine, metal parts/ash, and charcoal would be disposed of off-site in accordance with all applicable regulations. Agent-contaminated dunnage would be processed through incineration. Uncontaminated dunnage would be disposed of in an off-site permitted facility. Destruction of solid wastes produced from operations are not expected to result in significant impacts on waste management systems or the environment.

Wastes resulting from operation of either of the neutralization alternatives would include metal parts and dunnage as well as residues, such as scrubber sludge, biomass, and brine salts generated from processing the chemical agents and energetics. The residues could contain significant amounts of heavy metals. If stabilization of the solid residues would be required under RCRA, either an on-site process for stabilizing the solid wastes would be used, or alternatively, the wastes would be shipped off-site to an appropriately permitted TSDF where they would be stabilized and disposed. Operating plans call for recycling all process liquids back through the reaction vessel. Operations are not expected to result in significant impacts on waste management systems or the environment.

4.6.1 Current Waste Management and Facilities

PCD currently generates a variety of wastes associated with two of its missions: (1) storage of chemical munitions; and (2) environmental restoration of the installation for future property transfer. In the past, PCD operated both an on-site sewage treatment facility and a solid waste landfill. Sanitary wastes are now sent to lined evaporation lagoons (East Lagoons and Munitions Storage Area A Lagoons, Fig. 4.5), solid wastes are hauled off the site by a licensed contractor. Hazardous wastes are stored at several locations on-site including the short-term storage areas located west of the lagoons (see Fig. 4.5).

The Munitions Storage Area A Lagoons are lined, evaporative lagoons, built in 1995. The lagoons are located outside Munitions Storage Area A near the southeast corner. There are two cells, and each cell holds 3 million gal for a total capacity of 6 million gal. The lagoons are presently in use; they are receiving discharges from the change house in Munitions Storage Area A (presently, maintenance personnel and guards are the primary users of the change house). Currently the lagoons are operating well below capacity (about 0.001). The lagoons are lined and in good condition.

The Munitions Storage Area A Lagoons were never permitted because they were not intended to discharge any sanitary wastes; therefore, no National Pollutant Discharge Elimination System permit was required (per USEPA). The lagoons were constructed to receive domestic sewage from the "existing demilitarization facility" (change house with a full water distribution system), which was constructed in 1995 along with the lagoons. The Munitions Storage Area A Lagoons would serve the destruction facility when it is built.

The amounts and types of hazardous and sanitary wastes generated at PCD during 1999 are summarized in Table 4.3.

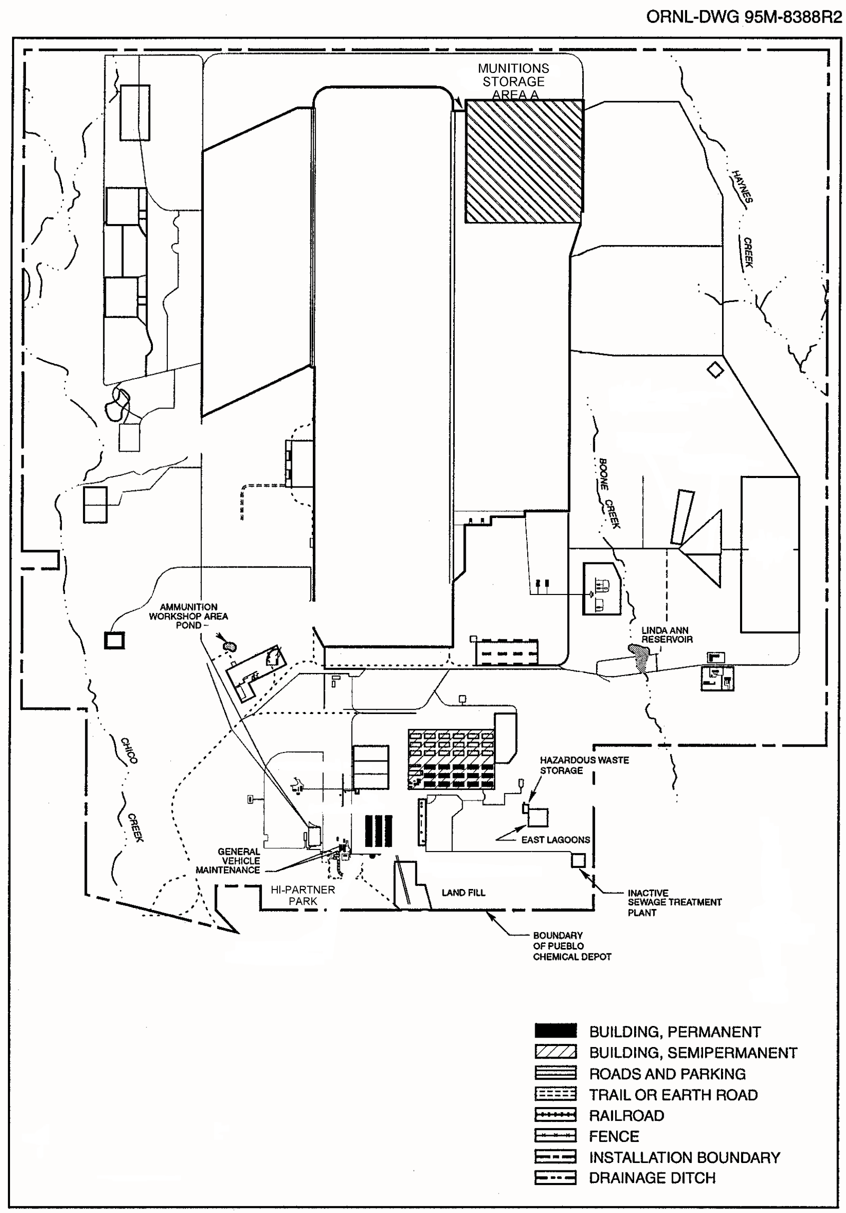


Fig. 4.5. Existing Facilities at Pueblo Chemical Depot. *Source:* PCD Environmental Database.

Table 4.3. Summary of wastes generated at Pueblo Chemical Depot in 1999

Type of Waste	Amount per Year[a]	Offsite shipment?
Hazardous liquids	16.94 ton[b]	Yes
Hazardous solids	6.1 ton	Yes
Hazardous contaminated soils	41.5 ton	Yes
Hazardous contaminated soils[c]	~7,500 ton	No
Contaminated groundwater[d]	205 million gal	No
Sanitary wastes	8 million gal	No

[a]Unit conversion 1 lb- 0.45 kg. 1 gal - 3.8 L.

[b]1999 numbers for hazardous solids and hazardous liquids include one-time disposalsof accumulated wastes (10,200 solid wastes) and expired decontamination fluid (2,100 liquid wastes). In 1997, annual accruals of hazardous solids and liquids were 8,300 lb and 21,000 lb, respectively.

[c]Contaminated soil is being composted at Building 591 [at a rate of approximately 7,500 tons/yr). The project that has been generating the contaminated soil (which is approved by the Colorado Department of Public Health and Environment (CDPHE)] is almost complete. Current plans call for the complete treatment of soil stored at Building 591 by 2001.

[d]Contaminated groundwater is generated by the on-post pump and treat system, ICAGRS (Interim Corrective Action Groundwater Remediation System).

Source: ACWA DEIS (ANL 2001a).

4.6.1.1 Hazardous wastes

Most hazardous wastes generated presently at PCD are packaged and transported off-site to appropriately permitted TSDFs. Army activities that are sources of hazardous wastes at PCD include:

- Facility maintenance (paints, solvents, water conditioners, etc.);
- Vehicle maintenance (used oil, batteries, coolant, etc.);
- Environmental restoration (contaminated soils, drill cuttings, personal protective equipment, etc.); and
- Chemical agent decontamination (field test materials, toxic chemical analysis reagents, personal protective equipment, etc.).

Hazardous wastes are stored at a number of locations on the PCD installation. These storage areas include a permitted hazardous waste storage building with secondary containment (Building 540), various temporary storage satellite accumulation points, investigation–derived waste storage areas for remediation wastes, and a temporary (90-day) drum storage area located outside and to the south of Building 529. Igloos G1009, G1109, and G1110 are permitted storage areas for both liquid and solid chemical munitions wastes (see Fig. 4.6). Igloos G1109 and G1009 have secondary containment features because of their liquid waste storage capability. Buildings 591 and 592 are permitted for storage of contaminated soil

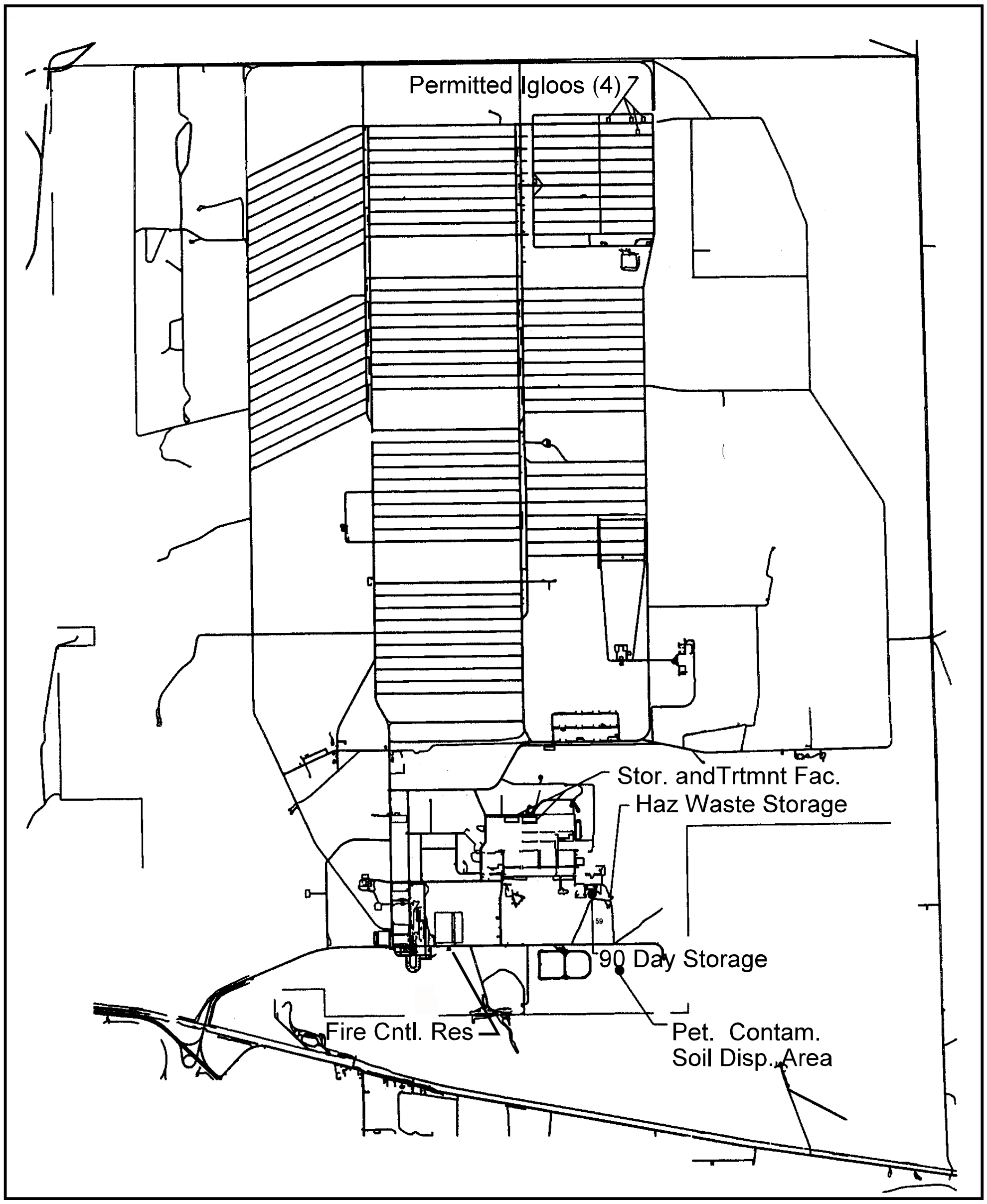


Figure 4.6. Locations of Hazardous Waste Storage Areas at PCD.

containing explosives obtained from environmental restoration activities associated with the former TNT washout facility. The project, which was approved by the Colorado Department of Public Health and Environment, is almost complete.

The master lease prohibits lessees' generation of wastes without prior approval and stipulates the conditions of approved waste generation (PDADA 2000a). (Currently no lessees have approval to generate waste.) Waste that might be generated by lessees or tenants are not included in Table 4.3. Tenants manage their own wastes as outlined in memorandum of understanding among PCD and its tenant organizations. None of the tenants generate significant quantities of hazardous wastes.

Implementation of the PCD hazardous waste management plan (U.S. Army 2000a) is the responsibility of the PCD Environmental Management Division. This division accepts and stores hazardous wastes generated at PCD. U.S. Department of Defense (DOD) policy dictates that the Defense Reutilization and Marketing Office take physical custody of hazardous waste whenever its storage capabilities are greater than or equal to the generator's capabilities. This office is also responsible for the ultimate destruction of hazardous waste stored at PCD. The Defense Reutilization and Marketing Office oversees the transportation of hazardous waste off-site to appropriately permitted TSDFs.

4.6.1.2 Nonhazardous wastes

Generation of sanitary wastes at PCD in 1999 totaled 8 million gal (Table 4.3). These wastes are pumped into lined evaporation lagoons. Nonhazardous solid wastes generated at PCD are transported to an off-site landfill/disposal facility.

4.6.2 Impacts of Construction

The potential waste management impacts of constructing a chemical munition destruction facility at PCD are assessed in the following sections. Construction materials would be delivered to the site primarily by semi-trucks, dump trucks, and concrete trucks. Non-hazardous construction waste would be collected in roll on/off dumpsters and transported to a nearby off-site landfill. Non-hazardous construction waste typically consists of wood, metals, and paper. Hazardous construction wastes typically include excess paint, oils, paint thinner. Any wastes from porta-johns would be handled through a local vendor and transported off-site to a sewage treatment facility.

In addition to standard OSHA and Army Corps of Engineers construction safety training, workers would be trained in the identification, handling, and disposal of all construction wastes. Workers would be provided the necessary personal protective equipment, and they would be given standard training in handling construction materials that would include familiarization with material safety data sheets for hazardous wastes. For work outside Munitions Storage Area A, it is expected that there would be no construction hazards that are not typical for a heavy industrial construction site. For work performed within Munitions Storage Area A, the Chemical Limited Area, protective masks would be required.

4.6.2.1 Impacts of constructing an incineration facility

All wastes resulting from constructing an incineration facility at PCD would be collected and disposed of in accordance with U.S. Army, state, and federal regulations. No significant impacts would be expected from the management and disposal of hazardous and nonhazardous wastes resulting from the construction of an incineration facility.

Hazardous Wastes. Construction of an incineration facility would generate small amounts of both solid and liquid hazardous wastes including solvents, paints, coatings, waste fuel/water, adhesives, empty containers, and concrete placement chemicals (Table 4.4). Any wastes that are listed as hazardous in the RCRA regulations would be stored and disposed of at an off-site TSDF as prescribed by EPA and applicable state and local regulations.

Nonhazardous Wastes. Construction would primarily generate solid wastes in the form of excavation spoils and building material debris. Excavation spoils would be used to the extent possible for backfill and reestablishing surface grade. Building material debris would be disposed of by transport off-site to a permitted landfill. Liquid nonhazardous wastes would include flushwater, sanitary waste (sewage), waste glycol, and concrete curing compounds. Sanitary waste would be handled by the use of portable toilets. Collected sanitary wastes would be transported to an appropriately permitted treatment works for disposal. The remainder of liquid nonhazardous wastes would be stored and disposed of in an appropriately permitted off-site disposal facility.

4.6.2.2 Impacts of constructing a neutralization facility

Construction activities would generate both solid and liquid nonhazardous wastes. Solid nonhazardous wastes would primarily be in the form of building material debris and excavation spoils. Liquid nonhazardous wastes would include wastewater from wash-downs and sanitary wastes. The nonhazardous wastes would be disposed of in an off-site permitted landfill.

Construction would also generate small amounts of both solid and liquid hazardous wastes such as solvents, paints, cleaning solutions, waste oils, contaminated rags, and pesticides. No significant impacts would be expected from the management and disposal of solid and liquid construction wastes (Table 4.4). The hazardous wastes would be collected on the site until they are shipped to an offsite, permitted TSDF.

Based on the quantities and types of construction wastes, no significant impacts would be expected to nearby or regional waste disposal facilities.

Table 4.4. Wastes generated from construction of the alternative destruction facilities

Impact Category	Baseline Incineration	Modified baseline incineration	Neutralization/ SWCO	Neutralization/ Biotreatment
Hazardous wastes				
Solids[a]	2 yd^3[(c)]	NA	70 yd^3	80 yd^3
Liquids[b]	3.2 thousand gal[d]	NA	28 thousand gal	31 thousand gal
Nonhazardous wastes				
Solids				
Concrete	NA	NA	160 yd^3	200 yd^3
Steel	NA	NA	32 tons	32 tons
Other	NA	NA	1,300 yd^3	1,600 yd^3
Liquids				
Wastewater	0.009 million gal[e]	NA	1.8 million gal	2.0 million gal
Sanitary	NA	NA	4.1 million gal	4.5 million gal
Other[f]	0.001 million gal[g]	NA		

Source: ACWA TRD (2001), Table 6.4-2. Baseline values are reported by the Army from construction of the destruction facility at Anniston, Alabama.

[a]Hazardous waste solids include adhesives, solvents, rags, and propane containers.

[b]Hazardous liquid wastes include fuel/water, concrete placement chemicals, waste paint, and coatings.

[c]Reported as 1760 lb, converted to a conservative volume by assuming that the waste density is one-half the density of water (31.214 lb/ft^3).

[d]Reported as 27,000 lb, converted to a conservative volume by assuming that the waste density is equal to the density of water (8.345 lb/gal).

[e]Reported as 73,000 lb, converted to volume by assuming that the wastewater has the density of water.

[f]Nonhazardous other liquids include waste glycol and concrete curing compounds.

[g]Reported as 11,000 lb, converted to a conservative volume by assuming that the density of the liquids is equal to the density of water.

NA = Not available.

4.6.3 Impacts of Operations

4.6.3.1 Mustard degradation products

Mustard degradation products may result from incomplete combustion and chemical reactions. Although not as toxic as mustard agent, care must be used to ensure that the degradation products are destroyed. The incineration technology assures their destruction with the secondary incinerator and the neutralization technologies assures their destruction with the SCWO and biodegradation. A list of mustard agent degradation products is shown in Table 4.5.

Degradation products of mustard agent would be produced by all of the proposed technologies. Decontamination activities (hydrolysis) to clean up agent would produce mustard agent degradation products during any of the destruction activities. Neutralization (hydrolysis), the first step in either neutralization with SCWO or neutralization with biodegradation, would produce mustard agent degradation products. All the degradation products of mustard agent are less toxic than mustard agent.

The principal degradation products of mustard undergoing hydrolysis are thiodiglycol (TDG) and hydrochloric acid (ACWA DEIS 2001). Table 4.5 presents a list of mustard degradation products and their physical properties. TDG is stable in the absence of water, is miscible with water, and has a half-life in aqueous solution of about 6 weeks. No aqueous photolysis occurred when aqueous solutions of TDG were exposed to sunlight for 14 days. TDG can be possibly oxidized to TDG sulfoxide and TDG sulfone. TDG, 2-chloroethyl vinyl sulfone, and divinyl sulfone are essentially nonvolatile (will not form vapors). Divinyl sulfide and 1,2-dichloroethane rapidly form a gas phase. Hemisulfur is not expected to persist in the environment, and it decomposes rapidly by hydrolysis.

Two common degradation products of HD that are persistent in the environment are 1,4-oxathiane and 1,4-dithiane (Table 4.5). 1,4-Oxathiane is formed by dehydrohalogenation of partially hydrolyzed mustard, whereas 1,4-dithiane is a thermal degradation product of mustard formed by dechlorination. Both compounds are contaminants in the Rocky Mountain Arsenal area near Denver, Colorado (ANL 2001a), and 1,4-dithiane has been identified in groundwater at Aberdeen Proving Ground, Maryland. 1,4-Dithiane readily vaporizes from both soil and surface water. It also photooxidizes to form sulfoxides and sulfones.

4.6.3.2 Impacts of incineration

Wastes from the operation of an incineration facility would include both hazardous and nonhazardous solid and liquid wastes. Liquids generated by the agent disposal process would be disposed of internally by incineration (e.g., spent decontamination solution) or shipped to a permitted, off-site TSDF (e.g., liquid brines). Specific processes for laboratory waste handling would be developed by the systems contractor, in a laboratory hazardous waste management plan. A summary of hazardous and non-hazardous wastes is presented in Table 4.6.

Table 4.5. Physical properties of mustard degradation products

Compound	Water Solubility (g/L)	Log K_{ow}[a]	Log K_{oc}[b]	Vapor pressure (mm Hg)
Sulfur mustard	1.0	1.37	2.12	0.1
Thidiglycol (TDG)	Miscible	-0.77	0.96	0.00002
2-Chloroethyl vinyl sulfide	1.4	1.11	1.98	5.8
Divinyl sulfide	2.5	-0.85	1.84	6.0
Mustard sulfoxide	93	-0.85	0.91	0.65
Mustard sulfone	11	-0.51	1.11	0.96
2-Chlorovinyl sulfoxide	160	-1.11	0.77	0.064
Vinyl sulfoxide	280	-1.37	0.63	0.92
2-Hydroxyethyl vinyl sulfide	5.0	0.53	1.66	3.8
2-Chloroethyl vinyl sulfone	78	-0.77	0.96	0.023
Divinyl sulfone	140	-1.03	0.82	0.09
1,4-Dithiane	3.0	0.77	1.80	0.81
1,4-Oxathiane	167	0.60	ND	3.9
1,2-Dichloroethane	11	1.48	2.18	8.5

[a]K_{ow} = Octanol water partition coefficient, an estimate of a chemical's tendency to bioaccumulate in organisms. High values of K_{ow} indicate that a substance will tend to concentrate in soil organic matter or in fatty issue rather than in water.

[b]K_{oc}=Organic carbon partition coefficient, an estimate of the tendency of a chemical to absorb to the organic carbon phase in soil or sediment. The greater the value of K_{oc}, the greater the tendency of a substance to stick to organic matter in soil and not migrate with water or vaporize into the air.

Source: ACWA DEIS (ANL 2001a) Appendix A.

Table 4.6. Estimated total wastes produced by operating a chemical agent destruction facility at Pueblo Chemical Depot

Impact Category	Baseline Incineration	Modified Baseline Incineration	Neutralization/ supercritical water oxidation	Neutralization/ biodegradation
Hazardous wastes				
Ash (from MPF and DFS)	1 ton[a]	1 ton[a]	NA	NA
Brine (from PAS treatment & water softening)	16.0 million gal	14.5 million gal	NA	NA
Brine salts	NA	NA	5060 ton	3660 ton
Biomass	NA	NA	NA	2560 ton
Energetics	1,065 ton[a]	1,065 ton[a]	Not specified[d]	Not specified[d]
Protective ensembles, contaminated	158.5 ton	60.2 ton	Not specified[d]	Not specified[d]
Laboratory wastes	0.0043 million gal[a]	0.0030 million gal[a]	Not specified[d]	Not specified[d]
Propellant	150 ton[a]	150 ton[a]	Not specified[d]	Not specified[d]
Spent decontamination solution (NaClO)	0.639 million gal	0.218 million gal	NA	NA
Dried spent decontamination solution (18 wt% NaOH, HaClO)	NA	NA	512 ton	351 ton
Spent hydraulic fluids	0.040 million gal[b]	0.028 million gal[b]	Not specified[d]	Not specified[d]
Wood dunnage, contaminated	9 ton[a]	9 ton[a]	Not specified[d]	Not specified[d]
Nonhazardous wastes				
Scrap metal parts	18,000 ton[a]	18,000 ton[a]	18,000 ton[a]	18,000 ton[a]
Spent charcoal filters (PAS & ventilation)	73 tons	63 tons	Not specified[d]	Not specified[d]
Ventilation system filters (HEPA & pre-filters)	65 tons	59 tons	Not specified[d]	Not specified[d]
Wood dunnage, uncontaminated	1731 ton[a]	1731 ton[a]	NA, all assumed to be contaminated	NA, all assumed to be contaminated

Table 4.6. (Continued)

Impact Category	Baseline Incineration	Modified Baseline Incineration	Neutralization/ supercritical water oxidation	Neutralization/ biodegradation
Protective ensembles, uncontaminated	17.7 ton	6.0 ton	NA, all assumed to be contaminated	NA, all assumed to be contaminated
Sanitary wastes (sewage)	27 million gal[c]	19 million gal[c]	15 million gal[c]	15 million gal[c]

[a]The waste quantities would be identical because the number of munitions and the amount of mustard agent are identical for all technologies.

[b]The incineration technologies would produce essentially the same amount of waste hydraulic fluid because the number of hydraulic machines and quantities of hydraulic fluid needed for either technology is very similar.

[c]The number of workers would be similar for all technologies.

[d]Waste would be processed in the ACWA destruction facility.

Source: ACWA *Technology Resource Document* (ANL 2001b), *Pueblo Modified Technology Input for the Environmental Impact Statement Analysis*, SAIC, June 2000 and personal communication from Penny Robitaille, PMCD, to Tim Ensminger, ORNL, January 7, 2002.

Solid process wastes would consist primarily of ash and scrap from the incinerators. Hourly waste generation rates are shown in Table 4.7. The total process solid waste expected to be generated during the life of the facility is 25,000 tons, a volume of about 550,000 ft^3. These quantities include approximately 18,000 tons of scrap metal primarily from munition bodies, which would be sold to a scrap dealer or smelter for reuse if possible. However, if selling the scrap metal were not possible, it would be disposed of in an off-site, permitted landfill. There would be over 630 truckloads of scrap metal leaving PCD (Table 4.8). Construction debris and some non–process wastes would be disposed of in a commercial landfill. Items of salvageable value would be provided to the Defense Reutilization Management Office for recycling.

Hazardous Wastes. Hazardous solid wastes would consist mainly of contaminated protective clothing, energetics propellants, contaminated dunnage, and ash residue from the furnace systems. Projected hazardous solid waste quantities are included in Table 4.6. The protective clothing and contaminated dunnage would be incinerated on-site. Energetics and propellants may be destroyed on-site. A decision would be made in November 2001 after evaluations of potential disposition methods have been completed. The remaining hazardous solid wastes would be stored and taken to an off-site permitted TSDF. Transportation of the solid hazardous wastes would require over 210 truck trips (Table 4.8). Based on the quantities and types of solid hazardous wastes produced, no significant impacts would be expected at off-site disposal facilities.

As shown in Table 4.6, baseline incineration and modified baseline incineration produce different quantities of wastes. The waste products that are tied directly to the inputs (number of munitions and quantity of mustard agent) are identical. These wastes include energetics, scrap metal, dunnage, and propellant. Although the number of incinerators differs, the quantity of ash is essentially the same because it would result from burning the identical materials. Spent decontamination fluid and protective ensembles are more numerous in the

Table 4.7. Summary of process wastes for an incineration facility at the Pueblo Chemical Depot

Source	Type	Generation rate[a] lb/hr
Metal parts furnace	Metal scrap, scrap/ash	10,280
Deactivation furnace	Scrap/ash	1,400
Liquid incinerator[b]	Solids	Negligible
Pollution abatement system	Liquid brines	830

[a]Rates are maximal and based on peak-limiting process step. Scrap rates reflect maximum throughput. The total solid process wastes (including protective suits and charcoal residue ash, in addition to munition-specific solid waste) that would be generated during the lifetime of the proposed destruction facility are expected to be about 25 thousand tons (550 thousand ft^3). This quantity does not include munition overpacks, or transport overpacks.

[b]The liquid incinerator would not be used in modified baseline incineration. Because its contribution to wastes is negligible, its inclusion would not bias an analysis of impacts.

Source: Ralph M. Parsons Co. 1988. *CSDP Waste Management Study*, prepared for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

baseline incineration waste because there is more agent clean-up required—munitions are not frozen in baseline incineration. Because there are more incinerators in baseline technology, there would be more filter waste than from modified baseline technology.

There would be a process liquid effluent from the facility: brine liquids generated from the pollution abatement equipment. The liquid brines, residuals from destruction processing, would be classified as a listed hazardous waste by the state of Colorado and retain that classification until delisted by the state.

Experience at JACADS has shown that incinerator ash is the primary recipient of heavy metals (cadmium, mercury, and lead). Occasionally the liquid brine has a sufficient concentration of lead (>5 ppm) for it to be classified as a characteristic hazardous waste. Table 4.9 Shows the average concentration of metals in liquid brine. Brine is estimated to be generated at an average rate of approximately 20,000 gal per day. The total quantity of brine which would be generated over the life of the facility would be approximately 16 million gal for a baseline facility and 14.5 million gal for a modified baseline facility. It would take over 3200 trips by 5000-gal tanker trucks to move all the liquid brines generated by the baseline facility and about 2890 trips to move all the liquid brines generated by the modified baseline facility (Table 4.8) to the disposal site. It is expected that four 40,000 gal storage tanks would be used to store liquid brine prior to offsite shipment to a permitted TSDF.

Table 4.8. Number of truckloads needed to remove wastes from Pueblo Chemical Depot

Impact Category	Baseline Incineration	Modified Baseline Incineration	Neutralization/ supercritical water oxidation	Neutralization/ biodegradation
Hazardous wastes				
Ash (from MPF and DFS)	1[a]	1[a]	NA	NA
Brine (from PAS treatment & water softening)	3200	2890	NA	NA
Brine salts	NA	NA	262	604
Biomass	NA	NA	NA	117
Scrubber sludge	NA	NA	NA	352
Other waste, solid	NA	NA	34	NA
Energetics	123[a,g]	123[a,g]	0[b]	0[b]
Protective ensembles, contaminated	0[b]	0[b]	0[b]	0[b]
Laboratory wastes	1.12[c]	0.60[c]	0[b]	0[b]
Propellant	17[a,g]	17[a,g]	0[b]	0[b]
Spent decontamination solution (NaClO)	126[d]	44[d]	NA	NA
Dried spent decontamination solution (18 wt% NaOH, NaClO)	NA	NA	42[e]	31[h]
Spent hydraulic fluids	0[b]	0[b]	0[b]	0[b]
Wood dunnage, contaminated	0[b]	0[b]	0[b]	0[b]
Nonhazardous wastes				
Scrap metal parts	635[a]	635[a]	1790[a,F]	1822[a,F]
Spent charcoal filters (PAS & ventilation)	4	3	0[b]	0[b]
Ventilation system filters (HEPA & pre-filters)	3	3	0[b]	0[b]
Wood dunnage, uncontaminated	90[a]	90[a]	NA, all assumed to be contaminated	NA, all assumed to be contaminated

Table 4.8 (continued)

Impact Category	Baseline Incineration	Modified Baseline Incineration	Neutralization/ supercritical water oxidation	Neutralization/ biodegradation
Protective ensembles, uncontaminated	0.5[c]	0.3[c]	NA, all assumed to be contaminated	NA, all assumed to be contaminated

[a]The number of munitions and amount of agent are identical for all technologies.
[b]Waste would be destroyed on-site. Mass reduced by up to 99.5%.
[c]If possible, fractional truckloads would be combined to minimize shipments.
[d]Existing plans call for the spent decontamination fluid to be incinerated on-site, but the possibility exists for shipment off-site.
[e]Roughly 75% of the 56 shipments required for the Nonprocess Waste category (ACWA TRD, Table 4.28).
[f]Shipped in 55-gal drums (ACWA TRD 2001, Table 4.28 and 4.55).
[g]Part of the 140 total shipments required to remove energetics and propellants.
[h]Roughly 69% or the 45 shipments required for the Nonprocess Waste category (ACWA TRD, Table 4.55).
Source: Incineration values derived from *Pueblo Chemical Demilitarization Facility (CDF) Transportation,* SAIC, May 24, 2001, *Transportation of Projectile Energetics Offsite*, SAIC, May 24, 2001 and personal communication from Penny Robitaille, PMCD, to Tim Ensminger, ORNL, January 7, 2002. ACWA technology values derived from ACWA TRD (ANL 2001).

The relatively large volume of brines from the PCD disposal facility would be disposed of at one or more permitted off-site TSDFs, with the consent of the affected states and the EPA. Presently the DCD destruction facility (TOCDF) is shipping liquid brines to a facility in Texas for deep well injection.

Nonhazardous Wastes. The primary nonhazardous liquid discharged from an incineration facility would be sanitary sewage, estimated to average about 20,650 gal/day. No process wastewater or hazardous liquid would be discharged into the sewage system. Sewage from the destruction facility would be processed in a packaged treatment system with effluent directed to lined evaporative lagoons in close proximity to the destruction facility.

Nonhazardous solid wastes would be collected and disposed of in an off-site permitted landfill. The quantities and types of nonhazardous wastes from operations would not be expected to produce significant impacts on nearby off-site or regional waste disposal facilities.

4.6.3.3 Impacts of neutralization

Hazardous Wastes. Wastes resulting from normal operations would include components from the treatment of metal parts and dunnage as well as process residues, such as contaminated salts generated from treating chemical agents and energetics. The neutralization facilities would produce brine salts as solid waste. These salts could contain significant amounts of toxic heavy metals (e.g., lead). If the hazardous brine salt failed the RCRA test, stabilization of the waste may be required for disposal. Either the waste would be stabilized prior to shipment to an off-site permitted TSDF or, alternatively, the waste would be shipped directly to an off-site appropriately permitted TSDF where it would be stabilized prior to disposal. The current plan is to construct a new facility for brine salt treatment near the proposed destruction site. The stabilization would likely take the form of grouting or encapsulation. The final decision would be made by ACWA prior to construction. The wastes expected to be generated from operation of the neutralization facilities are given in Table 4.6.

Table 4.9 Average metals in the liquid brines produced during the Trial Burn of 4.2 inch mortars rounds at JACADS

Metal analyte	Concentration (mg/L)
Aluminum	1.5
Antimony	0.051
Arsenic	0.9
Barium	<0.12
Beryllium	<0.02
Boron	8.5
Cadmium	8.5
Chromium	0.49
Cobalt	<0.1
Copper	1.46
Lead	1.63
Manganese	1.42
Mercury	0.0056
Nickel	1.35
Phosphorus	12.1
Selenium	<0.1
Silver	0.68
Tin	<0.02
Vanadium	<1
Thallium	0.1
Zinc	17.4

Current operating plans include recycling all process liquids obtained in the operation phase back through the reaction vessel. Such recycling in a closed-loop system would eliminate these liquids from the waste streams. No activities or operations that would result in significant impacts on waste management systems were identified.

It is assumed that most wastes generated by the proposed action would be collected and disposed of off the site in accordance with U.S. Army, state, and federal regulations. Any wastes listed as hazardous in the RCRA regulations would be stored and disposed of at an off-site TSDF as prescribed by the EPA and applicable state and local regulations. It is expected that hazardous wastes generated from destruction operations would not produce significant impacts at off-site disposal facilities.

Nonhazardous Wastes. Sanitary wastes generated during construction and operations could be disposed of on-site in a lined evaporative lagoon facility. The nonhazardous solid wastes would be disposed of in an off-site permitted landfill. The sanitary wastewater would be processed in a packaged treatment system with effluent directed to lined evaporative lagoons in close proximity to the destruction facility. The quantities and types of nonhazardous operation wastes would not be expected to produce significant impacts on off-site nearby or regional, waste disposal facilities (see Table 4.6).

4.6.4 Impacts of No Action

The no action alternative at PCD would be continued storage of the chemical weapons stockpile. No construction activities would be anticipated under the continued storage alternative. However, wastes would be generated during operations, during continuing inspection and maintenance activities. In addition, the continued degradation of agent containers over time would probably generate slowly increasing amounts of waste as the storage duration of the chemical munitions would be extended. Estimates of the wastes that would be generated from storing chemical munitions at PCD were taken from the 1999 *Biennial Hazardous Waste Report for PCD* (U.S. Army 2000); they are shown in Table 4.10.

Any hazardous waste would be stored on-site indefinitely until an off-site TSDF is identified.

Table 4.10. Hazardous wastes generated by the no action alternative

Impact Category	Quantity of Waste
Hazardous solids	
Solids from storage	0.25 tons per year
Contaminated soils	7.0 tons per year
Hazardous liquids	
Liquids from storage	2.6 tons per year

4.6.5 Cumulative Impacts

The Chemical Munitions Disposal Program is not long–lived. Construction and decontamination and decommissioning would each take 2 to 3 years. Operations would take about 2.5 years for modified baseline incineration and about 4.5 years for baseline incineration. Groundwater cleanup is the largest waste-related activity at PCD that is not related to the Chemical Munitions Disposal Program. Although it involves large volumes of water, the quantities of hazardous wastes extracted from the water do not presently challenge the capacities of the TSDFs available to the Army. The greatest potential for significant direct and cumulative impacts lies with the liquid brines. The Army is currently sending liquid brines from the DCD facility to a TSDF in Texas for deep well injection. A recipient must be identified that can treat and dispose of the liquid brines without being overwhelmed.

4.7 AIR QUALITY–CRITERIA POLLUTANTS

Criteria pollutants are defined as those pollutants regulated by National Ambient Air Quality Standards (NAAQS) which have been established to protect human health and welfare (40 CFR 50). The following sections discuss the impacts of a chemical munitions destruction facility on ambient-air concentrations of criteria pollutants, in the context of existing concentrations of those pollutants.

National Ambient Air Quality Standards (NAAQS) exist for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), lead (Pb), and particulate matter less than or equal to 10 µm in aerodynamic diameter (PM-10) and less than or equal to 2.5 µm in aerodynamic diameter (PM-2.5). These are called criteria pollutants because the criteria for regulating them must be published, reviewed, and updated periodically to reflect the latest scientific knowledge (Clean Air Act, Section 108). On July 18, 1997, EPA promulgated an 8-hour O_3 NAAQS to replace the 1-hour standard (62 FR 38856) and added NAAQS for PM-2.5 (62 FR 38652). These standards have survived court challenges (U.S. Supreme Court 2001) and are expected to be implemented in the near future when the required 3 years of data are available to determine compliance.

The NAAQS are expressed as concentrations of pollutants in the ambient air (i.e., in the outdoor air to which the general public has access [40 CFR Part 50(e)]. Primary NAAQS define levels of air quality that the U.S. Environmental Protection Agency (EPA) deems necessary, with an adequate margin of safety, to protect human health. Secondary NAAQS are similarly designated to protect human welfare by safeguarding environmental resources (such as soils, water, plants, and animals) and manufactured materials. Primary and secondary standards are currently the same for all pollutants and averaging periods except for 3-hour SO2 averages, which have a secondary standard only. States may modify NAAQS to make them more stringent, or set standards for additional pollutants. The State of Colorado has adopted more stringent values in some cases as noted in the following sections.

Cumulative impacts are evaluated in this EIS with respect to NAAQS, which define levels of air quality to protect human health and welfare with an adequate margin of safety. NAAQS are used in this analysis as standards by which to measure the significance of the atmospheric concentrations of air pollutants due to all sources in the area, including the maximum contributions expected to result form the proposed project.

4.7.1 Existing Meteorology, Existing Air Quality, and Emissions

4.7.1.1 Existing meteorology

The climate of the area surrounding PCD is semiarid and marked by large daily temperature variations. The following description of climate is based on data from 1954 through 1997, recorded at the Pueblo Municipal Airport located about 10 miles west southwest of PCD (NOAA 1999) except for the wind data that were measured at the PCD on-site meteorological tower (i.e., the DEMIL tower).

The wind rose, which is based on data recorded on site at PCD for the two-year period 1998 through 1999, is shown in Fig. 4.7 (Rhodes 2000). For the 1998-1999 period, average annual wind speed was about 8.5 mph, and the seasonal average wind speed of 9.8 mph was highest in spring. The wind rose indicates that the prevailing wind at PCD is from the north-northwest, with a secondary peak from the southeast. Irrespective of the season, diurnal

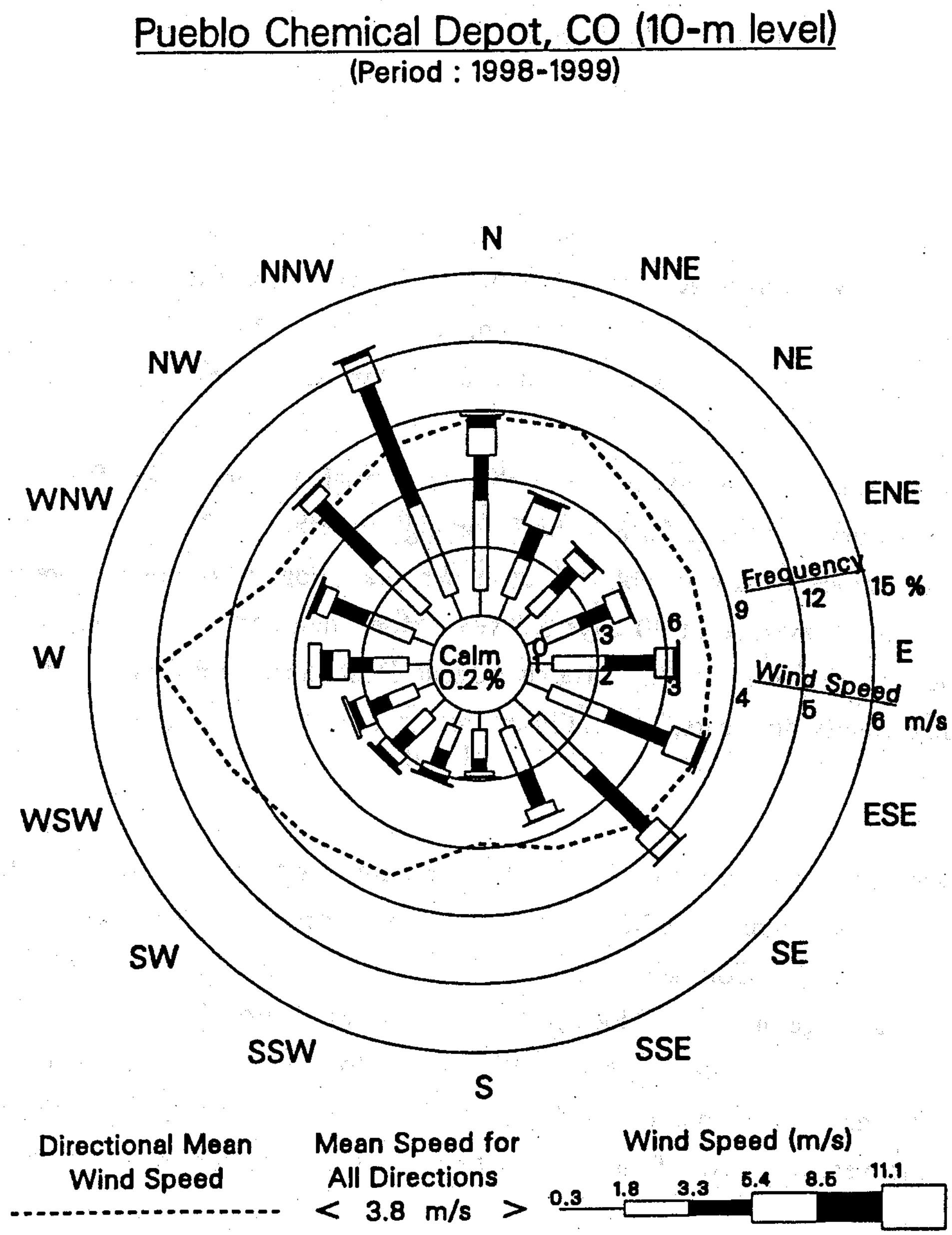


Fig. 4.7. Wind Rose.

variation in wind direction occurs throughout the year, with a wind from the southeast during the day and a wind from the north-northwest at night. In general, wind speeds at night tend to be lower than those during the day. During the 1998-1999 period, the highest wind speed measured at PCD was about 44 mph.

The average temperature at the Pueblo Memorial Airport is 52°F. January is the coldest month, averaging 30°F, and July is the warmest month, averaging 76°F. Extreme temperatures have ranged from -28°F, which has occurred twice (January 4, 1959 and December 12, 1961) to 108°F on June 29, 1990. The freeze-free period is about 153 days, extending from the beginning of May through the end of September (U.S. Department of Commerce 1968). Temperatures of 90°F or higher occur on an average of 65 days per year, with 55 of those days occurring during June, July, and August. Winter cold spells are sometimes broken after a few days by warm, dry winds from the west.

Average annual precipitation at Pueblo Memorial Airport is about 12 in. About three-fourths of the annual precipitation falls during April through September. July and August have the most precipitation, averaging about 2.0 in and 2.1 in respectively. The greatest amount of precipitation in a single month was 5.9 in occurring in August 1955, and the greatest amount in a 24-hour period was 3 in on August 29, 1955. Snowfall averages about 33 in. The greatest amount of snow reported in a single month was 25.6 in, which occurred in November 1991, and the greatest amount during a 24-hr period was 16.8 in April 1990.

Average relative humidity at Pueblo Municipal Airport ranges from 36% to 41% for the daytime hours, and from 58% to 68% for night-time hours. Low humidity in the region limits the occurrence of fog to about 8 days per year. Fog in summer is very rare. Thunderstorms occur on an average of 40 days per year. More than 85% of the thunderstorms occur during the four-month period of May through August. Dust storms are frequent during the spring months of abnormally dry years, especially in areas where dry farming (farming without irrigation) is practiced.

Tornadoes are rare in the area surrounding PCD and are less frequent and destructive in the region than they are in the Midwest. For the 46-year period of 1950 through 1995, 1161 tornadoes were reported in Colorado, with a tornado event frequency of 2.4×10^{-4} per year per square mile and an average of 25 tornadoes per year (Storm Prediction Center 2000). For the same period, only 9 tornadoes were reported in Pueblo County, with a tornado event frequency of 8.2×10^{-5} per year per square mile, or about 1 chance in 12,000 of striking somewhere within Munitions Storage Area A in any given year.

4.7.1.2 Existing air quality

PCD is located in the San Isabel Intrastate Air Quality Control Region (AQCR), which includes the following counties: Chaffee, Custer, El Paso, Fremont, Huerfano, Lake, Las Animas, Park, Pueblo, and Teller). The Colorado State Ambient Air Quality Standards (SAAQS) for six criteria pollutants—sulfur dioxide (SO_2), particulate matter (PM), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and lead (Pb)—are almost identical to the National Ambient Air Quality Standards (NAAQS) (Colorado Department of Public Health and Environment 1999).

A small difference exists with respect to Pb; although the NAAQS (1.5 $\mu g/m^3$) is specified as an average for a calendar quarter, Colorado regulations make that averaging period equal to one month. Thus, the Colorado standard is somewhat more stringent because the national standard would allow, for example, a concentration of 2 µg/m^3 for an individual month, as long as the average concentration for the other 2 months in that calendar quarter is less than 1.25 µg/m^3, so the 3-month average would be less than 1.5 µg/m^3. Because monitoring indicates that concentrations are less than 0.03 µg/m^3 (less than 2% of the standard) for all individual months, this difference between the national and state standards is considered to be insignificant with respect to this EIS, and will not be discussed further.

The only substantial difference between the state and national standards involves 3-hour averages of SO_2, for which the Colorado standard of 700 µg/m^3 (Colorado Ambient Air Quality Standard I.A) is much more stringent than the national standard of 1300 µg/m^3 (40 CFR 50). The NAAQS, Colorado's SAAQS, and the highest ambient air pollutant concentrations at the nearest monitoring stations to PCD are given in Table 4.11. Pollutants are often measured at locations where high concentrations are likely to occur. Therefore, the concentrations around PCD are likely to be lower, in general, than the data in Table 4.11 indicate. The values in Table 4.11 are maximum concentrations over a 5-year period. However, occasional anomalous exceedances of a standard are specifically considered in the regulations for purposes of deciding whether an area is in attainment or nonattainment of the standards. For example, the 1-hour and 8-hour standards for carbon monoxide specifically exclude the respective maxima for each year. The highest 1-hour value given in Table 4.11 is 15,065 µg/m^3, or 38% of the standard; however, when the maximum 1-hour concentration for each year was excluded, the highest remaining 1-hour concentration was 12,995 µg/m^3, or 32% of the standard. The highest 8-hour concentration given in Table 4.11 is 8,740 µg/m^3, or 87% of the standard; when the maximum 8-hour average for each year was excluded, the highest remaining 8-hour concentration was 5750 µg/m^3, or 58% of the standard given in Table 4.11. For the 8-hour ozone averages, the maximum value was 159 µg/m^3, or 96% of the standard; however, the standard actually applies to the 3-year average of the fourth-highest annual values, which is 129 µg/m^3 or 78% of the standard. Nonetheless, the maximum values in Table 4.11 are always below the corresponding standards, indicating that the air quality in the region round PCD is generally good.

The state of Colorado also has a visibility standard which limits the maximum permitted light extinction coefficient to 0.076 per kilometer (equivalent to a minimum visual range of about 32 miles) averaged over a 4-hr period between 8 a.m. and 4 p.m. local time. This standard applies, when the relative humidity is less than 70%, to a program area that includes the Denver Metropolitan area but does not include PCD or any other areas in Pueblo County. The nearest location to PCD subject to this visibility standard is about 15 miles north of PCD, at the El Paso County Line.

Pueblo County is designated as being in attainment of NAAQs for SO_2, NO_2, and O_3 [Title 40, Part 81, Section 306 of the *Code of Federal Regulations* (40 CFR 81.306)]. Not enough data are available to support a classification for CO or PM-10, so a designation of "unclassifiable" is given for those pollutants. However, measurements of CO were discontinued in 1986 because monitoring had indicated very low concentrations, and data from the City of Pueblo show that PM-10 concentrations are well below the NAAQS (Table 4.11). Only PM-10 was monitored in Pueblo during the 1990s, and recently PM-2.5 (PM with an aerodynamic diameter of $\leq$2.5 µm) measurements were initiated (Rink 2000). Particulate matter is emitted from vehicular traffic on unpaved roads, agricultural activities, and mining. Pueblo has not had any violations of the PM-10 standard since it was put in place. No designation

Table 4.11. Maximum measured ambient air concentrations of criteria pollutants at the monitoring stations nearest PCD during the 5-year period 1996-2000.

Pollutant	Averaging period	Year[a]	Location[b]	Air quality standard (µg/m³)	Concentration (µg/m³)	Concentration as a percent of standard
Sulfur dioxide (SO_2)	3-hour	1996	R. D. Nixon Power Plant	700	168	24
	24-hour	1996		365	29	8
	annual	2000		80	5	6
Carbon monoxide (CO)	1-hour	1997	Near I-25 & Uintah[d]	40,000	15,065[d]	38
	8-hour	1996		10,000	8,740[d]	87
Nitrogen dioxide (NO_2)	annual	2000	R. D. Nixon Power Plant	100	17	17
Ozone (O_3)[e]	1-hour[e]	1999	Air Force Academy	243	174	72
	8-hour[e]	2000		165[e]	159	96
Lead	3-month[f]	1999	Colorado Springs	1.5	0.01[f]	<1
Particles < 10µm in diameter (PM-10)	24 hour	2000	Pueblo[g]	150	66	44
	annual	1999	Pueblo[g]	50	22	44
Particles<2.5 in diameter (PM-2.5)[g]	24 hour	[g]	Pueblo[g]	65	13[g]	20[g]
	annual	[g]	Pueblo[g]	15	7[g]	47[g]

[a]The year of the highest value is given; in case of a tie, the most recent year is given.

[b]The nearest location with data for the 5-year period 1996-2000.

[c]Units are micrograms per cubic meter.

[d]These measurements were taken near Interstate 25: the concentrations are likely to be much higher than near Pueblo Chemical Depot.

[e]An 8-hour standard for ozone was promulgated by EPA in 1997 (FR 62 38856). Although some aspects of the implementation of that standard, as originally promulgated, did not withstand judicial review (U.S. Supreme Court 2001) the numerical value of that standard is retained in this EIS.

[f]The 3-month period is defined as a calendar quarter. Quarterly averaged lead concentrations have been at or below 0.02 micrograms per cubic meter (about 1% of the corresponding standard) since the first quarter of 1994. A Colorado standard for emission of hazardous air pollutants (Regulation 8) effectively reduces the averaging interval from a (3-month) calendar quarter to one month. The difference is insignificant, as discussed in the text.

[g]Particulate-matter data are from the monitor at 211 D Street, which began operation in 1998. New standards for very fine particulate matter, equal to or less than 2.5 µm in diameter IPM-2.5). Have been promulgated, survived court challenges, and will become effective when sufficient monitoring data are in place. It is likely that these standards will be effective during construction and operation of the proposed facility. Data are currently insufficient for a multi-year evaluation. Highest 24-hour PM-2.5 concentrations in Pueblo ere reported as 12 µg/m³ in CDPHE (2000a); however, the monitoring period was too short to capture representative highest values. Therefore, the background value suggested by CDPHE (2001), of 25 µg/m³ was used for the cumulative impact analysis summarized in Table 4.11.

(attainment, nonattainment, or unclassifiable) is given for Pb in Colorado, although data from various parts of the state indicate that concentrations have been less than 1% of the standard for more than 5 years.

Prevention of Significant Deterioration (PSD) regulations (40 CFR 52.21) limit the maximum allowable increments in ambient concentrations of SO_2, NO_2 and PM-10 above established baseline levels, as shown in Table 4.12. The PSD regulations, which are designed to prevent deterioration of air quality in areas where the air is already clean, apply to major new sources of pollutant emissions, and to major modifications of existing sources. The state of Colorado contains 12 Class I PSD areas; these areas, which include national parks and national wilderness areas, are protected by more stringent standards than those which apply to other areas of the country (Class II areas). The PSD Class I area that is nearest to PCD is the Great Sand Dunes National Monument, located 75 miles west-southwest of PCD. The monument is not located downwind of prevailing winds at PCD, and the Sangre de Christo Mountains just east of this Class I area provide a partial barrier to the transport of pollutants from the area surrounding PCD under most meteorological conditions.

Table 4.12. Allowable increments for the prevention of significant deterioration (PSD) of air quality[a]

		Allowable increment ($\mu g/m^3$)[b]	
Pollutant	Averaging period	Class I Areas[c]	Class II areas[c]
Sulfur dioxide	3-hour[d]	25	512
	24-hour[d]	5	91
	annual	2	25
Nitrogen dioxide	annual	2.5	25
PM-10[e]	24-hour[d]	8	30
	annual	4	17

[a]Source: Code of Federal Regulations (CFR); see, for example, 40 CFR 51.166 40 CFR 5.21.

[b]Concentration units are micrograms per cubic meter; if no value is given, no corresponding standard exists.

[c]Class I areas are especially designated to provide strict protection against the deterioration of air quality; these areas include many national parks, and monuments 40 CFR 51.166. Class II areas currently include all areas in the United States that are not Class I. The Clean Air Act (Sec. 163) allows for a Class III designation, but no such area has yet been so designated.

[d]Not to be exceeded more than once per year.

[e]Particulate matter less than 10 micrometers in aerodynamic diameter.

4.7.1.3 Existing emissions

The latest estimates of air emissions of criteria pollutants from existing sources at PCD come from PDA (1995). Estimates of each pollutant are given below in tons per year, and as a percentage of the total emissions in Pueblo County. Pueblo County anthropogenic emissions of criteria pollutants are taken from the NET data base of the U.S. Environmental Protection Agency (EPA web site (EPA 2001). Because biogenic emissions of VOCS (about 5 tons per square mile) exceed anthropogenic emissions in Pueblo County, both sources are included in the calculation of the percentage value for VOCs. Emissions from PCD in 1994, and their respective percentages of Pueblo County emissions the same year (in parentheses) are: 1.91 tons of SO_2 (0.02%), 1.98 tons of NO_x (0.02%), 5.04 tons of CO (0.01%), 15.87 tons of VOCS (0.1%), and 13.1 tons of PM-10 (0.1%). The only remaining criteria pollutant is lead (Pb), which is emitted only in minuscule quantities as a trace metal in fuel used for combustion.

4.7.2 Criteria Pollutant Emissions

Impacts of constructing and operating a chemical munitions destruction facility are expected to be very minor with respect to NAAQS and SAAQS. Impacts of construction would primarily involve fugitive dust from construction and earthmoving activities: these are discussed in the following section. Impacts of operation of a baseline incineration facility would primarily involve emissions from the common stack (serving the liquid incinerator, the deactivation furnace system, metal parts furnace), the boiler stacks (for providing hot water and process heat), and vent stacks for the laboratory and the MDB.

Operation of a modified incineration facility would involve a maximum of two incinerators, a metal parts furnace, for burning the mustard agent directly from the munitions bodies, and possibly a deactivation furnace for destruction of the energetic components of the munitions. The neutralization alternatives would not involve use of an incinerator but would include oxidizers and other potential pollutant sources, including utility boilers for producing heat. Air quality impacts of emissions from these sources are discussed in Sect. 4.4.

4.7.3 Impacts of Construction

Construction-related emissions and resulting increases in ambient-air concentrations of pollutants would be about the same for any of the four destruction alternatives. Fugitive dust resulting from excavation and earthwork would dominate the air-quality impacts of any construction involved; no exceedances of NAAQS would be expected for either type of facility.

Existing literature provides estimates of construction-related particulate emissions in terms of mass generated per unit area per unit time. This literature is periodically updated by EPA (2001). Emissions parameters have been input to an EPA-recommended air dispersion model that provides estimates of construction-related increases in atmospheric concentrations (mass per unit volume) of contaminants at and beyond the PCD site boundary. Modeled increases in particle concentrations have been added to measurements of existing background concentrations in the region (taken from data available on EPA's web site), and the sums have been compared to NAAQS given in Chapter 40, Part 50 of the Code of Federal Regulations (CFR) to assess the possibility that construction activities would lead to exceedances of the NAAQS.

Fugitive Dust. Large amounts of fugitive dust would result from excavation and earthwork. The impacts of this dust on off-site PM-10 concentrations were modeled using the EPA-recommended Industrial Source Complex Short-Term (ISCST3) air dispersion model (EPA 1995). An average emission factor for total suspended particulate (TSP) matter of 1.2 tons per acre per month (EPA 1985) was used, and 30% of that amount was assumed to be PM-10 (EPA 1988). The entire area that would be occupied by incineration facilities, and related facilities including a parking lot, was assumed to be under construction at all times; because construction activities usually occur in phases, the actual area under construction on any given day is likely to be much less, especially for earthwork activities involving installation of utilities such as pipes or power lines. A phased approach of construction was assumed, in which the largest area under construction at any one time was assumed to be no greater than 30 acres (i.e., an area of that size was used in the modeling). Although the exact area and location of the facility site is not yet specified, the area selected for modeling (just east of the midpoint of the east side of Munitions Storage Area A) is closer to the nearest resident than are most other probable construction Areas. Routine dust suppression measures (e.g., sprinkling with water) were assumed to reduce emissions by 50% (EPA 1985).

Two years (1998 and 1999) of hourly surface meteorological data from a location about 6600 ft northwest of the proposed facility were used in the modeling. Mixing heights, which are important in determining the vertical extent of pollutant dispersion, were calculated using upper air data from Denver (the nearest location for which upper-air data are available). Concentrations of PM-10 were modeled for 306 receptors (specified locations) along the depot boundary and in the surrounding area. Flat terrain was assumed for this fugitive dust analysis. This is a conservative assumption (i.e., leading to overestimates) for ground-level releases because the pollutant plume is assumed to travel the shortest possible distance between the source and any given receptor (i.e., to travel through obstacles such as hills, rather than over or around them).

Modeled PM-10 concentrations resulting from the proposed construction were added to estimates of existing background dust concentrations in the region provided by CDPHE (2001). These values are conservative indicators of ambient concentrations applicable to the general geographic area, but do not represent monitoring data from the immediate vicinity of PCD, which would be preferable. Actual concentrations at particular locations within the broad area around PCD are subject to spatial variations, especially for particulate matter, and also to temporal variations including long-term trends. Thus, on-site PM-10 sources were also included in the modeling. Additionally, some effects of the R.D. Nixon Powerplant may not be represented in the background estimates (CDPHE 2001). Therefore, that source was also included, although its effects were small, at least partly due to its considerable distance from PCD.

Results of this modeling are presented in Table 4.13. No exceedances of, or close approaches to, the NAAQS for PM-10 are expected to result from construction of the proposed facility.

The NAAQS for PM-2.5 were promulgated in 1997, and have only recently been upheld by the U.S. Supreme Court. A multi-year data set sufficient for estimating background concentrations is not yet available, nor are generally accepted estimates of construction emissions for use in atmospheric dispersion modeling. However, the NAAQS for PM-2.5 are likely to apply to the proposed construction activity; therefore, preliminary estimates of related environmental impacts are presented.

First-cut estimates of background PM-2.5 values have been provided by CDPHE (2001); these are included in Table 4.13. For modeling purposes, emissions of PM-2.5 were assumed to be half of the PM-10 emissions (i.e., half of the PM-10 emitted was assumed to be PM-2.5). Results are presented in Table 4.13. No exceedances of the NAAQS for annual or 24-hour NAAQS for PM-2.5 would be expected to result from the proposed construction activity.

Table 4.13. Effects of site construction on ambient air concentrations of particulate matter at the point of maximum impact[a]

Averaging period	Estimated background concentrations (μg/m³)[b,c]	Maximum model concentration (μg/m³)[c]	Total estimated concentration (μg/m³)[c]	NAAQS (μg/m³)[c]	Total estimated concentration as a percent of NAAQS
PM-10[d]					
24-hour	40	46	86	150	58
annual	17	4	21	50	42
PM-2.5[d]					
24-hour	25	23	48	65	74
Annual	7	2	9	15	60

[a]The location of the highest modeled concentration.

[b]Because the NAAQS allow for one anomalous exceedances of the standard each year, the 24-hour background values for both sizes of particulate matter represent annual second-highest values.

[c]Units of concentration are micrograms per cubic meter (μg/m³).

[d]PM-10 is particulate matter equal to or less than 10 millionths of a meter 10 μm) in diameter; PM-2.5 is particulate matter equal to or less than 2.5 μm in diameter.

Because the NAAQS, which are set to protect public health and welfare with an adequate margin of safety (40 CFR 50), would not be expected to be exceeded or closely approached as a result of the proposed construction activity, expected air quality impacts would be minor.

As noted above, dust suppression measures (e.g., sprinkling with water) would be used as necessary to control fugitive dust and comply with local and state laws and regulations concerning the control of dust generated by construction activities.

Vehicular Emissions. Temporary and localized increases in atmospheric concentrations of nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), volatile organic compounds (VOCs), and particulate matter would result from exhaust emissions from workers' vehicles, heavy construction vehicles, diesel generators, and other equipment during construction of a baseline incineration facility. These emissions would be similar to those from typical industrial construction projects, and would have negligible impacts on ambient air quality.

4.7.4 Impacts of Operations

Table 4.14 presents a comparison of emissions of criteria pollutants and VOCs from routine operations of the incineration and neutralization technologies. In general, incineration would lead to greater emissions of criteria pollutants. Emissions of VOCs are smaller for the incineration technologies, but are very small in all cases.

The period of operations for baseline and modified incineration has changed since the Draft EIS to 65 and 30 months respectively (Section 2.3.4). The analysis of air quality impacts has not changed because the effect of lengthening the period of operations is to reduce air emissions. Therefore, the existing analysis provides a conservative upper bound of the impacts.

4.7.4.1 Impacts of incineration alternatives

Fugitive Dust. Impacts of a modified incineration facility would be equal to or less than the impacts of a baseline facility. Fugitive dust would arise as a result of commuter traffic and other vehicles transporting materials on site. This dust would be comparable with other industrial activities involving the same numbers of workers, and would be small compared to the construction impacts discussed in Sect. 4.7.3.

Process and Stack Emissions. This section addresses the air quality impacts of routine operation of a baseline incineration facility, which are expected to be greater than the impacts of a modified incineration facility (U.S. Army 2000b). The greatest source of air pollutants would likely be the common stack serving the liquid incinerator, metal parts furnace, and the deactivation furnace system. In addition, there would be two proposed stacks for boilers to produce building heat, plus ventilation outlets for various buildings, most notably the laboratory and the MDB, from which very small amounts of agent could possibly be emitted to the atmosphere.

Other potential sources of air pollution include vehicular traffic, which would include cars, pickup trucks, and buses transporting personnel to and from the facility. There would also be movement of materials by truck and forklift. All roads within the facility would be paved to minimize fugitive dust. Storage tanks are a potential source of pollutants. Fuel storage would be in above-ground tanks; the capacity of these tanks would only need to be sufficient to support short-term operations (i.e., a few days' fuel supply). Raw material and agent feed tanks would also be a part of this facility. Modified incineration would not require feed tanks because the agent would be frozen within the munition bodies.

Potential impacts of emissions to the atmosphere resulting from operation of baseline incineration facilities are evaluated by (1) modeling the resulting maximum ground-level concentrations of pollutants, (2) adding these estimates to background concentrations in the area, and (3) comparing the total concentrations to air quality standards. This procedure is the same as that used to assess the temporary impacts of construction; results are given in Table 4.15.

Criteria pollutants include: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO),ozone (O_3), lead (Pb), and particulate matter in 2 size classes: equal to or less than 10 micrometers in diameter (PM-10), and equal to or less than 2.5 micrometers. Ozone is not emitted directly, but is formed from photochemical reactions (reactions requiring sunlight) involving its precursors, oxides of nitrogen (NO_x) and volatile organic compounds VOCs, which are emitted directly. The reactions involved are complex and typically take hours to complete; therefore, ozone concentrations cannot be estimated directly from calculations of atmospheric dispersion, but must instead be estimated indirectly from the emissions rates of

Table 4.14. Peak and annual emission rates of criteria pollutants and volatile organic compounds for incineration and neutralization technologies

Pollutant[a]	Baseline technology[b]		Modified baseline technology[b,d]		Neutralization/ Biotreatment[b]		Neutralization/ SCWO[b]	
	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
NO_x	49.30	175.41	41.40	175.41	52.40	21.08	54.70	24.93
VOCs	0.16	1.10	0.16	1.10	4.16	1.44	4.25	Ng
SO_2	12.03	36.20	11.73	36.20	3.22	0.98	3.23	0.99
CO	9.70	36.97	8.40	36.97	12.80	7.07	14.20	9.38
PM_{10}	2.00	12.47	1.80	12.47	3.62	1.38	3.74	1.59
$PM_{2.5}$[c]	2.00	12.47	1.80	12.47	3.62	1.38	3.74	1.59
HC	ng	ng	ng	ng	ng	ng	ng	1.59

[a]Criteria pollutants and their chemical symbols are: sulfur dioxide (SO_2), nitrogen dioxide NO_2, Carbon monoxide (CO), Particulate matter less than 10 micrometers in diameter (PM-10), Ozone (O_3), and lead (Pb). Volatile organic compounds are abbreviated as VOCs, and total hydrocarbons as HC.

[b]Occasional emissions from emergency diesel generators are not counted in this comparison. They would be expected to be comparable for the various technologies.

[c]$PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions. Highest 24-hour PM-2.5 concentrations in Pueblo were reported as 13 µg/m^3 in CDPHE (2000a); however, the monitoring period was too short to capture representative highest values. Therefore, the background value suggested by CDPHE (2001), of 25 µg/m^3 was used for the cumulative impact analysis summarized in Table 4.11.

[d]Emissions from a modified baseline technology are conservatively assumed to be equal to those of a baseline facility; emissions from a modified baseline facility are actually expected to be lower.

ng = not given

*Sources:*For neutralization technologies: *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement Volume 4: Assembled Systems for Weapons Destruction at Pueblo Chemical Depot*. ANL/EAD/TM-101 Environmental Assessment Division, Argonne National Laboratory, May 2001

For Incineration Technologies: *Application for Air Pollution Emission Permit for the Department of the Army, Pueblo Depot Activity, Chemical Agent Disposal Facility*, submitted to the Colorado Department of Public Health and Environment, Air Pollution Control division, September 1995.

Table 4.15. Criteria pollutant impact analysis of a baseline incineration facility

Pollutant	Averaging period	Expected maximum concentration increase (µg/m^3)[a]	Background concentration (µg/m^3)[a,b]	Estimated cumulative impact (µg/m^3)[a]	Ambient air quality standard (µg/m^3)[a]	Impact as a percentage of the standard[c]
Ozone	1-hour	<6[d]	162	<168[c]	243	70 (<3)[c]
	8-hour	<5[d]	137	<142	165	86 (<4)[c]
Nitrogen dioxide	Annual	3	19	22	100	22 (14)
SO_2	3-hour	44	101	145	700	21 (6)[c]
	24-hour	9	39	48	365	13 (2)[c]
	Annual	1	8	9	80	11 (1)[c]

[a]Units are micrograms per cubic meter (µg/m^3); a microgram is a millionth of a gram.
[b]Background concentrations were provided by CDPHE (2000b, 2001).
[c]The total concentration is expressed as a percentage of the standard; the numbers in parentheses represent
the maximum concentration attributable to the proposed incineration facility as a percentage of the standard.
[d]The complexities of ozone modeling preclude an exact estimate, therefore an upper-bound estimate was derived as discussed in the text.

VOCs and NO_x given by PCD (1995). NO_x consists of NO and NO_2; most NO_x that is emitted from stacks is NO, but it quickly oxidizes to NO_2; therefore, regulatory control of stack emissions usually concerns NO_x but the regulation of ambient-air concentrations involves only NO_2.

A baseline incineration facility would be expected to emit about 1 ton per year (TPY), or about 0.01% of current anthropogenic emissions in Pueblo County. A baseline incineration facility would emit about 175 tons per year of NO_x, or less than 2% of the current Pueblo County emissions. Based on summaries of the results of ozone-concentration modeling as presented by Carter (1994), and on data analyses, such as that presented by Graedel and Crutzen (1993), it is unlikely that ozone concentrations could increase by more than about 2-3% of their current values as a result of additional VOCs and NO_x emissions expected from the proposed facility. Background ozone levels near PCD are given as 162 µg/m^3 (1-hour average) and 137 µg/m^3 (8-hour average); these are both less than 90% of their respective standards.

Maximum values of expected atmospheric emissions of NO_x as NO_2, were input to the EPA-recommended ISCST3 air dispersion model to calculate ground-level NO_2 concentrations that could result from operation of baseline facilities. Aerodynamic downwash was conservatively incorporated into the modeling by assuming that each stack would be surrounded by structures 0.8 times the height of the stack. All emissions were conservatively assumed to be at their maximum value (rather than their annual average value) at all times. Pollutant concentrations were modeled at 301 receptors (specified locations) around PCD. Elevations of the receptors with respect to the elevation of the proposed facility were considered in the modeling. The highest concentration of receptors was along the north and east boundaries of

PCD. These are the locations nearest an incineration facility to which the general public would have access. Receptor locations are shown in Fig. 4.8.

Results of air dispersion modeling are summarized in Table 4.15. The maximum increase in annual average NO_2 concentration that would be expected to result from operation of a baseline incineration facility is 3 μg/m^3. When added to the maximum background of 19 μg/m^3, the result is 22 μg/m^3, or 21% of the NAAQS. Therefore, no exceedances of, or close approaches to, the NAAQS would be expected to result from operation of a baseline incineration facility.

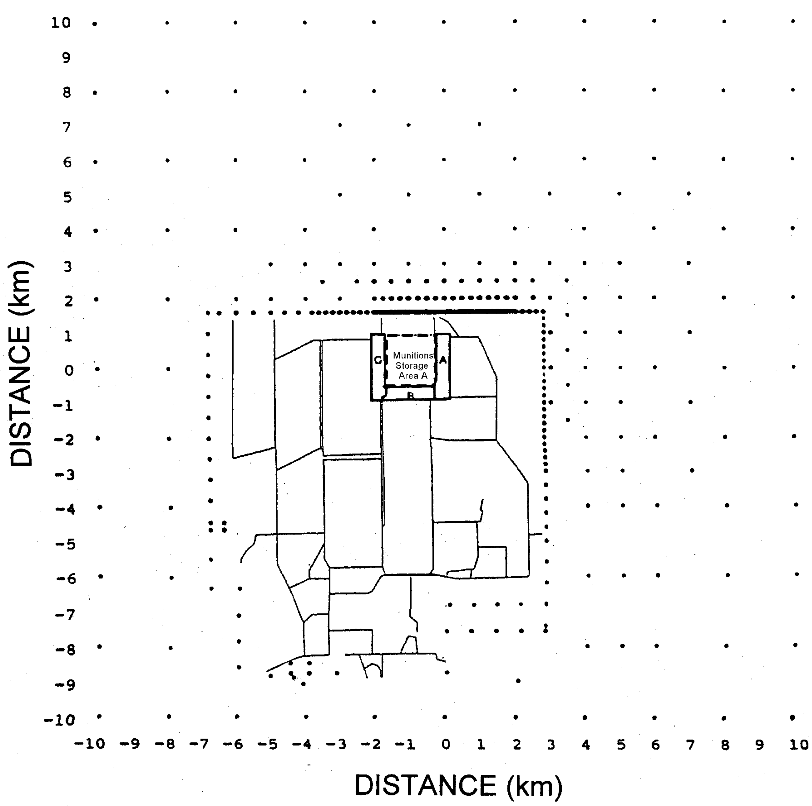


Fig. 4.8. Location of Modeling Points Used in Air Quality Modeling (EOC = on site administrative area).

SO_2 and PM-10 emissions would be expected to be below the significance levels given in 40 CFR 51.166, at which further analysis is required; however Colorado has more stringent levels of emissions that trigger a modeling requirement (APCD 2001), and SO_2 and PM-10 emissions from the proposed facility could exceed these levels (PDA 1995). Therefore, SO_2 and PM-10 emissions were subjected to dispersion modeling. Results indicated that PM-10 concentrations would be far below the significance levels for ambient air concentrations (APCD 2001) and these results will not be discussed further. Concentrations of SO_2 could exceed such levels at the PCD boundary and at a few nearby locations within 400 m (0.25 mile) of the PCD boundary. Therefore, maximum modeled concentrations at or outside the PCD boundary are also given in Table 4.15. It is seen that cumulative SO_2 concentrations would remain below 25% of the corresponding state or national standards in all cases, and that the maximum SO_2 concentration increment expected from the proposed facility would be less than 10% of those standards at the point of maximum impact (at the site boundary).

Impacts of the operation of a baseline incineration facility on the nearest Class I PSD area [Great Sand Dunes National Monument, located about 75 miles (121 km) west-southwest of the preferred site of the proposed facility] would be negligible due to the small amounts of pollutants released and the large distance between PCD and this Class I PSD area. The only pollutant expected to be emitted from a baseline incineration facility in greater quantities than the significant levels (40 CFR 51.166) requiring further regulatory analysis would be NO_2. The maximum allowable NO_2 increment for a Class I area is an annual average of 2.5 $\mu g/m^3$. Modeled concentration increases never exceeded that amount beyond 0.6 mile (1 km) from the PCD boundary. Because the prevailing winds at PCD are not toward this Class I area, annual average concentrations of pollutants from PCD would be further reduced.

Class II areas presently include all areas in the United States that are not Class I; the maximum modeled NO_2 concentration increase near the site boundary (the point of maximum impact) was 3 $\mu g/m^3$, or 12% of the maximum allowable increment (25 $\mu g/m^3$) for a Class II area (e.g., Pueblo County). Moreover, total concentrations would not be expected to exceed the allowable increment.

The impacts of process and stack emissions on ambient-air concentrations of criteria pollutants were analyzed by adding the maximum concentration increases expected to result from that facility to the maximum existing concentrations. The resulting cumulative concentrations were compared to the NAAQS, which were established to protect human health and welfare with an adequate margin of safety (40 CFR 50). Results, summarized in Table 4.15 indicate that none of those standards would be exceeded or closely approached as a result of operation of a baseline incineration facility. Impacts of operating a modified incineration facility would be expected to be less; therefore, air-quality impacts of operating either incineration facility are expected to be very minor with respect to the NAAQS.

Vehicular Emissions. Emissions of criteria pollutants from commuter traffic and transport of materials necessary for the operation of a baseline incineration facility would be no greater than for any other industry employing similar numbers and types of vehicles. Therefore, impacts of vehicular emissions to the atmosphere are expected to be very small.

4.7.4.2 Impacts of neutralization alternatives

Air quality monitoring data equivalent to that for incineration are not yet available for neutralization. However, projected emissions from routine operations of either type of neutralization facility would be less than the significance levels defined in 40 CFR 166 (b)(23)(i), and therefore would be considered too small to require further regulatory analysis.

Moreover, conservatively modeled maximum ambient-air concentrations of criteria pollutants, based on those emission rates, are always less than the levels defined in 40 CFR 165 (b)(2) as causing or contributing to a NAAQS exceedance. Because the expected air-quality impacts of a neutralization facility fall below these *de minimis* levels, the effect of such a facility on ambient air quality in the region is considered to be negligible.

4.7.5 Impacts of Process Fluctuations

4.7.5.1 Impacts of incineration alternatives

Process fluctuations may result from short-term variations (i.e., less than 15 min) in the properties of fuel or waste being fed to the combustor (EPA 1994). Such conditions are assumed to increase organic emissions to 145% of their normal values, and metals emissions to 280% of their normal values (NRC 1997), over long time periods. Carbon monoxide is the only criteria pollutant that could qualify as an organic; multiplying CO emissions by 1.45 does not result in emissions that would exceed the significance levels requiring further regulatory analysis (40 CFR 51.166) (i.e., emissions would still be small). Volatile organic compounds (VOCs) contribute to the formation of ozone, a criteria pollutant; multiplying VOCs emissions by 1.45 would result in about 1.6 tons per year, or less than 0.02% of the current anthropogenic component of VOCs emissions in Pueblo County, being emitted from the proposed facility. Therefore, the upper-bound estimate of ozone-concentration increase due to the proposed facility, discussed in Sect. 4.7.4.1 would not change.

White lead was used as a lubricant in fabricating the 105 and 155 mm projectiles; some of this lead may still be present. This could result in lead emissions from the metal parts furnace, and very small amounts of this lead could escape the pollution abatement system. These emissions would be far below the amounts necessary to cause any exceedance of, or close approach to, the NAAQS for lead. Atmospheric concentrations of lead have decreased to a small fraction of NAAQS over the last 25 years, primarily due to the decreased use of leaded gasoline.

4.7.5.2 Impacts of neutralization alternatives

Because of the absence of an incinerator and its attendant operations, air quality impacts of either neutralization alternative are expected to be less than those of either incineration alternative. Therefore, when fluctuations are considered, the impacts of criteria pollutants involved would still be expected to be insignificant.

4.7.6 No Action

Without emissions resulting from operation of any new facilities, the only expected changes in air quality would be those that will occur anyway (i.e., no impacts would be expected from no action). There may be no long-term impacts that are reasonably foreseeable, but the probability of an unusual event, leading to releases that might not be acceptable, would increase as the storage time at the facility increases.

4.7.7 Cumulative Impacts

The impact analysis presented in Section 4.7.4 indicated that pollutant emissions from routine operation of the proposed destruction facility would not lead to any exceedances of, or close approaches to, any ambient air standard for criteria pollutants. Moreover, impacts on air quality at the nearest Class I area for prevention of significant deterioration of air quality (Great Sand Dunes National Monument) would be negligible due to the small amounts of pollutants released and the large distance (75 miles) between the area and PCD. Construction of either type of facility could result in the release of up to 36 tons per month of fugitive dust, assuming that 30 acres were undergoing heavy construction for the entire month. About 30% of this dust would qualify as PM-10 (EPA 1988).

With Other On-post actions. Impacts of a destruction facility on ambient air concentrations of pollutants regulated by NAAQS would be expected to be very minor, as would the combined effect of a destruction facility and other past, present, or reasonably foreseeable future on-post activities.

With Other Off-post actions. No reasonably foreseeable off post actions are expected to appreciably increase concentrations of pollutants regulated by the NAAQS in areas most affected by incineration or neutralization destruction facilities. For example, a cement kiln that might be located more than 10 miles from Munitions Storage Area A would not be expected to contribute particulate matter in excess of the amounts that would contribute to a violation of a NAAQS. The effects of the West Plains Generating Station and Comanche Power Plant located more than 12 miles SW of the depot are included in PM10 monitoring data in the City of Pueblo. The contribution of existing NO_2 and SO_2 sources to cumulative effects has been assessed by the U.S. Army (1997). Results indicated that no health-based standards for criteria pollutants would be exceeded or closely approached as a result of operating the proposed facility.

4.8 AIR QUALITY–RELEASE OF HAZARDOUS AND TOXIC SUBSTANCES

Some substances (e.g., dioxins and mustard agent) are potentially hazardous in very small concentrations. In some cases, airborne concentrations of these pollutants may be below the detection limits of present monitoring instruments, precluding pollution control based on ambient-air monitoring. In cases where pollutants can be detected, the maintenance, chemical analyses, and data processing are often laborious, leading to unacceptable delays and costs, and, often, to error terms that are often large compared to the value obtained. Moreover, it is difficult to reach agreement on which substances are most important to monitor, and what limits or standards are necessary to protect public health. For many of these reasons, regulatory control of hazardous/toxic air pollutants is attempted by controlling emissions at their sources, where concentrations are highest, and, therefore, relatively easy to measure. It is only necessary to monitor at locations where emissions occur, and to monitor only those substances likely to be emitted by a particular industry or activity.

4.8.1 Existing Emissions and Air Quality

Existing emissions of hazardous and toxic air pollutants resulting from routine operations at PCD are small and arise primarily from fuel combustion for commuter vehicles, heaters, generators, etc.

4.8.2 Hazardous and Toxic Air Pollutant Emissions

Construction and operation of a chemical munition destruction facility would be required to comply with related standards for emissions and resulting ambient-air concentrations (e.g., 40 CFR 264-266) to assure that public health, safety and welfare are protected.

4.8.3 Impacts of Construction

Hazardous and Toxic Air Pollutants. Releases of hazardous and toxic air pollutants from construction would not be expected to exceed those from any similar construction project. Trace amounts of toxic metals are routinely emitted to the air as a result of combustion in diesel engines; impacts are negligible.

Release of Agent. It is not expected that any material containing mustard agent would be used or disturbed during construction; therefore, it is not expected that any mustard agent would be released to the atmosphere during construction activities.

4.8.4 Impacts of Operation

4.8.4.1 Impacts of incineration alternatives

Hazardous and Toxic Air Pollutants. Mustard agent contains chlorine, which can combine with other elements during the incineration process to form a variety of chlorine-containing compounds. These include dioxins, furans, polychlorinated biphenyls (PCBs) and hydrochloric acid (HCl). Stack-gas measurements of these compounds during verification testing at JACADS indicated that emissions of these compounds were within applicable standards or limits. Results for dioxins/furans, PCBs, and HCl are summarized in Table 4.16. Additional material on the results of the tests at JACADS has been published by U.S. Army Environmental Hygiene Agency (USAEHA 1993) and United Engineers and Constructors (UEC 1992, 1993). Based on this experience, the impacts of chlorine containing substances that may be formed during baseline incineration of mustard agent are expected to be small.

A trial burn of 4.2 inch HD mortar rounds was recently conducted at JACADS to show compliance with the operating permit of the MPF. Stack-gas concentrations of mercury as high as 142 µg/dscm were detected even though mercury was not detected in the feed samples. The new stack gas emissions standard for mercury is 45 µg/dscm (40 CFR 63.1203). Enhanced monitoring, design changes, and operational modifications will be employed to maintain the emission rate below the standard. For more information, see Section 4.9.3.3 concerning health effects.

Table 4.16. Performance experience of the JACADS baseline incineration facility for chlorine containing substances emitted from incineration of mustard agent

Substance(s)	Performance	Applicable requirement and reference
Dioxins/furans	Stack gas concentrations always <1.48 ng/dscm[a]	Stack gas concentrations always < 13/dscm[a] (40 CFR 60.52b[b]
PCBs	DRE[c] ≥ 99.9999%	DRE ≥ 99.9999% [Toxic Substance Control ACT (TSCA)]
Hydrogen chloride	0.02 lb/hr	The larger of 4 lb/hr or 99.99% removal efficiency (40 CFR 264.343)[b]

[a]Nanograms (billionths of a gram) per dry standard cubic meter (corrected to 7% oxygen).

[b]Regulations are always subject to change, those given in the table are the ones in affect at the time of the Tests. Since then, standards for hydrogen chloride emissions, applicable to the treatment and disposal of waste military munitions, have been adopted (40 CFR 266.206). These standards apply to emissions based on stack parameters (e.g., stack height, temperature of the exhaust gas leaving the stack, etc.). Those parameters for JACADS are not likely to be the same as for a baseline incineration facility at PCD. Nonetheless, any facility at PCD would be required to comply with the standards for treatment and disposal of military waste munitions.

[c]DRE: Destruction and Removal Efficiency. In some cases measurements of DRE are limited by detection limits.

Nitroglycerin is another pollutant that was measured during performance tests at JACADS; according to the Resource Conservation and Recovery Act (RCRA), a 99.99% destruction and removal efficiency (DRE) is required. Performance at JACADS indicated the DRE was always greater than 99.99884%.

Release of Agent. No mustard agent was detected in the stack during trial burns for a liquid incinerator at JACADS (UEC 1993), where detection limits were 18 to 23% of the upper limit of 0.03 mg/m^3 established by the Department of Health and Human Services (DHHS) to prevent adverse human health impacts [53 *Fed. Regist*. (pt.50)].

The ISCST3 dispersion model was used to estimate ambient-air concentrations of mustard agent resulting from routine operation of an incineration facility. Modeling protocol was the same as for the modeling of criteria pollutants in Sect. 4.7.4. Because no agent is released to the atmosphere during normal depot activities, background values of mustard agent in the vicinity of PCD were assumed to be zero.

Experience at JACADS and DCD indicates that the destruction and removal efficiency (DRE) achieved by incineration facilities for chemical warfare agent approaches 100%, but emissions from incinerator stacks cannot be characterized as zero. Therefore, modeling assumptions regarding emissions from an incineration facility are much more conservative than for routine operation of a chemical treatment facility. For purposes of this analysis, the emission rate for mustard agent from an incineration facility was here assumed to be equal to the upper limit of 0.03 mg/m^3 established by DHHS. Because this is much greater than the actual rates measured at JACADS, the modeled maximum ambient-air concentrations of mustard agent are likely to appreciably overestimate expected concentrations. Nonetheless, the modeled ambient-air concentrations presented in Table 4.17, are small compared to ambient-air concentration standards set by the DHHS to prevent adverse human health impacts (*Fed. Regist.* 53, March 15, 1988, p. 8506).

Table 4.17. Modeled concentrations of agent HD during performance of a baseline incineration facility at JACADS

Average period[a]	Maximum modeled concentration increase (ng/m^3)	Upper limit for ambient-air concentration (ng/m^3)	Modeled concentration as a percentage of the upper limit
8-hour	32	3000	1
72-hour	12	100	12

[a]The 8-hour standard applies to workers the 72-hour standard applies to the general population. Average concentrations for 72-hour periods are not easily obtained from the model code. Therefore, the maximum 24-hour average is used as a conservative estimate (i.e., an overestimate).

Metals. Atmospheric emissions of target metals were measured during trial burns at JACADS. The metals were either not detectable or were below EPA's established levels of concern. Based on performance at JACADS, (UEC1993, USAEHA 1993), atmospheric emissions of metals are expected to be within applicable standards; ambient-air concentrations are, therefore, also expected to be within any applicable standards or reference concentrations. Standards for metals emissions, applicable to the treatment and destruction of waste military munitions, are given in 40 CFR 266.206. These standards depend on stack parameters (e.g., stack height, temperature of the exhaust gas leaving the stack, etc.). Any facility at PCD would be required to comply with all applicable standards.

4.8.4.2 Impacts of neutralization alternatives

The risks of releases of hazardous and/or toxic air pollutants during routine operation of either type of proposed pilot test facility have been calculated at 2% or less of allowable levels. Therefore, the air quality impacts of these releases are considered to be small.

4.8.5 Impacts of Process Fluctuations

4.8.5.1 Impacts of incineration alternatives

Process fluctuations may result from short-term variations (i.e., less than 15 min) in the properties of fuel or waste being fed to the combustor (EPA 1994). Such conditions are assumed to increase organic emissions to 145% of their normal values, and metals emissions to 280% of their normal values (NRC 1997). Operation verification testing at JACADS included such conditions; nonetheless it may be prudent to assume that these conditions could occur a larger percentage of the time if an incineration facility were operating at PCD. Multiplying the emission rates of dioxins and other organic substances at JACADS by 1.45 would not result in any exceedances of present limits. In any case, PCD would be required to demonstrate compliance with any and all short-term and long-term emissions limits required by Colorado Department of Public Health and Environment (CDPHE).

4.8.5.2 Impacts of neutralization alternatives

The risks of releases of hazardous and/or toxic air pollutants during routine operation of either type of proposed pilot test facility have been calculated at 2% or less of allowable levels. Therefore, impacts of multiplying releases by 1.45 (for organic substances) or 2.8 (for metals) are still considered to be small.

4.8.6 No Action

Without emissions resulting from operation of any new facilities, the only expected changes in air quality would be those that will occur anyway (i.e., no impacts would be expected from no action). There may be no long-term impacts that are reasonably foreseeable, but the probability of an unusual event, leading to releases that might not be acceptable, would increase as the storage time at the facility increases.

4.8.7 Cumulative Impacts

With Other On-post actions. Impacts of a baseline or modified incineration facility on ambient air concentrations of hazardous and toxic pollutants would be expected to be small. Atmospheric emissions are expected to be mostly restricted to vehicular traffic and similar small emission sources that are typical of light industrial activity. Emissions of hazardous or toxic air pollutants from diesel vehicles are extremely small. Routine operation of a chemical munitions destruction facility would not be expected to add appreciably to emissions of hazardous or toxic air pollutants at PCD; therefore, cumulative effects would be similar to the current impacts from the baseline facility which are expected to be small.

With Other Off-post actions. No reasonably foreseeable off post actions are expected to appreciably increase concentrations of toxic or hazardous pollutants at locations most affected by incineration. Because neutralization technologies are designed to release no agent to the atmosphere, the routine operation of such facilities would be expected to have virtually no impact on ambient-air concentrations of hazardous and toxic pollutants. Only trace amounts of such pollutants would arise from diesel vehicles; such impacts would be negligible.

4.9 HUMAN HEALTH AND SAFETY–ROUTINE OPERATIONS

This section evaluates the on- and off-post health impacts of existing conditions, construction, systemization and operation of the four alternatives that could accomplish the destruction of the mustard chemical agent and munitions stored at PCD. Human health impacts have been divided into two categories; on-post workers and residents and off-post population. On-post workers and residents include all workers and residents physically located on the Pueblo installation. Off-post population includes the general public located in communities off-post surrounding PCD. Occupational accidents and injuries are also treated in this section.

4.9.1 Existing Conditions

Currently the PCD's operations involve monitoring stored munitions. There are few sources of atmospheric emissions except for those related to heating and transportation. Quantities of criteria pollutants are described in Sections 4.7 and 4.8. The emission rates described are not expected to result in significant health impacts either on- or off-site.

PCD employs approximately 185 people, of whom 78 are associated with chemical stockpile maintenance. There are also approximately 30 employees working for on-site commercial and industrial tenants. In addition, 60 people currently reside on PCD in the housing area in the southwest section of the depot.

The types of workers currently employed at PCD include environmental protection specialists, fire and emergency services specialists, facility management and maintenance workers, and administrative and office workers. The hazards associated with these jobs vary; workers receive training to address their specific job hazards. Although occupational hazards exist for all types of work (rates for various industry classifications are published; for example, see National Safety Council [1999]), these hazards can be minimized when workers adhere to safety standards and use protective equipment as necessary.

On-site workers and residents at the PCD site could be exposed to chemicals released to air, water, or soil. PCD does not currently emit any reportable quantities of HAPs as defined in Title III, Section 112 of the CAA. Contaminant levels in PCD releases to water are subject to applicable NPDES regulations. Most nonhazardous solid wastes and hazardous liquids and wastes that are generated at PCD are sent off-site for treatment. Sanitary waste is sent to holding ponds and is not discharged to nearby waterways. Therefore, any existing emissions or contamination at PCD should not result in increased health risks to workers or on-site residents. Emergency response capability is discussed in Section 4.26.3.

4.9.2 Impacts from Construction

This section identifies the human health impacts of construction for each of the four alternatives under consideration at PCD. Also included in this section are standard industrial accidents that will accompany construction of the facility. Construction related atmospheric emissions and resulting increases in ambient-air concentrations of pollutants are discussed in Section 4.7.3. These would be similar for all four alternatives. Conclusions are that no exceedances of PM_{10} or $PM_{2.5}$ are anticipated nor are exceedances expected for any criteria pollutants.

4.9.2.1 Impacts from incineration alternatives

The extent of excavation and fill work and design of the drainage systems for a baseline incineration facility would be approximately the same as for the modified incineration facility (U.S. Army 2000). Therefore, the results presented below are applicable for both incineration alternatives. However, the peak construction personnel for the modified incineration facility would be less than that of the baseline incineration facility. It is estimated that the manpower requirements for construction of the modified incineration facility would be approximately 75% of that of the baseline incineration facility (U.S. Army 2000b). Therefore, estimates of construction worker fatalities and injuries for the modified incineration facility were determined by calculating 75% of the baseline incineration facility's worker fatalities and injuries.

On-post workers and residents. The chemical agent storage area itself has been designated a solid waste management unit, as well as being classified as an area requiring environmental evaluation due to the suspected presence of mustard agent and mustard degradation products (USATHAMA 1990). The proposed site for the destruction facilities is outside the existing storage yard and is adjacent to no other areas of known environmental problems (USATHAMA 1990).

No on-post human health impacts are expected from construction activities or from exposure to possibly contaminated soils during earthwork. Monitoring would be conducted during construction and earthmoving activities to ensure that appropriate actions are taken if contaminated soils are encountered. It is anticipated that some exposures to solvents, caustics and other chemicals will occur during construction, but no unusual materials are anticipated to be used. Therefore, construction would not affect air quality to the extent of causing human health impacts. No deleterious effects to the on-post workers and residents' health are expected from construction activities.

The potential for human health impacts due to construction of the destruction facility would be limited to occupational hazards. Routine and well-known safety hazards would be present during the operation of heavy construction vehicles and machinery. The occupational health impacts from construction would be minor during routine activities because standard procedures, construction practices, and protective clothing and equipment would be used by workers to minimize exposure to unhealthy levels of noise and airborne emissions.

Baseline and Modified Incineration Occupational Worker Fatality and Injury Rates. The expected number of construction worker fatalities and injuries were calculated on the basis of data from the Bureau of Labor Statistics as reported by the National Safety Council (1999) and on estimates of total worker hours required for construction activities. Annual construction fatality and injury rates were used. The incidence rates are as follows:

- estimated fatalities during construction are 13.9 per 100,000 workers per yr;
- estimated injuries during construction are 4.4 per 100 full-time workers per yr;

Fatality and injury numbers were calculated using the appropriate incidence rate, the number of years for construction, and the number of full-time-equivalent employees. The estimated fatalities and injuries are shown in Table 4.18. The available fatality and injury statistics by industry are not refined enough to warrant analysis of workers as separate classes. It was assumed that any activity would result in some estimated risk of fatality and injury. Although this statistic is not used in this EIS, approximately 20 million person-hours have been accumulated during construction of incineration facilities without a fatality (personal communication, K. Gildner, PMCD to J. Terry, ORNL, Sept. 26, 2001).

Table 4.18. Estimated construction fatalities and injuries over the total period of construction

Alternative	Worker Fatalities	Worker Injuries
Baseline	None (<1)	60
Modified	None (<1)	45
Neutralization/SCWO	None (<1)	57
Neutralization/Bioremediation	None (<1)	48

[a]Modified incineration is estimated at 75% of baseline.

Off-post population. Since no adverse health effects would be expected for on-post non-construction workers and residents, no adverse health impacts for the off-post population would be expected.

4.9.2.2 Impacts from neutralization

On-post Workers and Residents. The potential for human health impacts due to construction of the destruction facility would be limited to occupational hazards. Routine and well-known safety hazards would be present during the operation of heavy construction vehicles and machinery. The occupational health impacts from construction would be minor during routine activities because standard procedures, construction practices, and protective clothing and equipment would be used by workers to minimize exposure to unhealthy levels of noise and airborne emissions. No human health effects to the on-post workers and residents are expected from construction activities from either the neutralization/SCWO facility or the neutralization/biotreatment facility.

Neutralization Occupational Worker Fatality and Injury Rates. The potential for human health impacts due to construction of either neutralization destruction facility are limited to occupational hazards. Occupational fatalities and injuries are limited when construction workers follow safety standards, best work practices and use personal protective equipment (PPE). Occupational worker fatality and injury rates are presented in Table 4.18.

For the construction of the Neutralization/SCWO facility, there would be no worker fatalities expected and up to 57 worker injuries were estimated. For the construction of the Neutralization/Biotreatment facility, it was estimated that there would be no worker fatalities and up to 48 worker injuries.

Off-post population. Since there are no adverse health effects expected for on-post workers and residents, no adverse health impacts for the off-post population are expected. While there is a potential for adverse occupational health impacts for construction workers, it would be limited to construction workers on-post and would not impact the off-post population.

4.9.3 Impacts of Operations

This section identifies the impacts of incident-free destruction operations at PCD. Incident-free operations are defined as those that occur without an accidental release of chemical agent into the environment. This section does include a discussion of occupational worker industrial accidents. Destruction operations involve the steps necessary to destroy the chemical munitions, including handling at the existing storage site, on-post transport of chemical agents and munitions from the storage site to the destruction facility, and destruction plant operations. The impacts of concern from incident-free destruction operations include potential exposure to low–but permitted–levels of chemical agent, criteria pollutants, and products of incomplete combustion (e.g., dioxins and furans).

4.9.3.1 Occupational worker fatality and injury rates

The expected number of systemization and operations worker fatalities and injuries were calculated on the basis of data from the Bureau of Labor Statistics as reported by the National Safety Council (1999) and on estimates of total worker hours required for systemization and operations activities. Annual manufacturing fatality and injury rates were used. The specific rates are as follows:

- estimated fatalities during systemization and operations are 3.2 per 100,000 workers per yr;
- estimated injuries during systemization and operations are 4.8 per 100 full-time workers per yr.

Fatality and injury numbers were calculated using the appropriate incidence rate (given above), the number of years for systemization and operations, and the number of full-time-equivalent employees. The estimated fatalities and injuries rates are shown in Table 4.19. The available fatality and injury statistics by industry are not refined enough to warrant analysis of workers as separate classes. It was assumed that any activity would result in some estimated risk of fatality and injury.

Table 4.19. Estimated systemization and operations worker fatalities and injuries over the total period of operations

Alternative	Worker Fatalities	Worker Injuries
Systemization		
Baseline	None (<1)	27
Modified	None (<1)	20
Neutralization/SCWO	None (<1)	15
Neutralization/Biotreatment	None (<1)	15
Operations		
Baseline	None (<1)	73[a]
Modified	None (<1)	55[a]
Neutralization/SCWO	None (<1)	30
Neutralization/Biotreatment	None (<1)	30

[a]The injuries for operations of the baseline and modified incineration are estimated using 36 and 24 months of operation. Changes in operational times from these values will effect in direct proportion the estimated number of worker injuries.

4.9.3.2 Discussion of principal hazardous chemicals

Mustard agent. The mustard agents to be destroyed at PCD are hazardous to humans. The type and extent of hazard are determined by the physical characteristics of the agent, the quantity and mode of release, the duration of exposure, and the prevailing meteorological conditions. Table 4.20 summarizes agent characteristics and toxicity; a much more detailed description of agents and their antidotes is provided in FPEIS (U.S. Army 1988).

Table 4.20. Chemical agents stored at the Pueblo Chemical Depot and biological/physical characteristics relevant to their toxic effects

Chemical agent	Chemical Abstracts Service (CAS) no.	Chemical name	Mode of action	Special characteristics: Acute toxicity	Special characteristics: Chronic toxicity
HD (Mustard gas, sulfur mustard)	505-60-2	Bis(2-chloroethyl) sulfide	Blister agent	Produces skin blisters, damages eyes and respiratory tract. Toxic effects are delayed (latent period); therefore, exposed personnel may not seek immediate treatment. Secondary infections of damaged tissue can easily occur. Eye is most sensitive organ; instant removal of agent required if no symptomology is to be seen. High doses can induce acute systemic reactions and injury to the immune system.	Carcinogenic under appropriate conditions of exposure. Potential increased risk of chronic bronchitis after exposure. Mutagenic in a wide variety of test systems. Teratogenesis studies were negative; one dominant lethal mutagenic study was positive. Potential for permanent impairment of vision if eye damage is severe. Skin lesions may show permanent changes in pigmentation and be hypersensitive to mechanical injury.
HT		Approx. 60% HD, 40% T	Blister agent	More toxicologically active than HD for skin blister development and inhalation lethality. More vesicant than HD.	Probably carcinogenic and mutagenic due to presence of HD. No experimental information on HT.
T[a]	63918-89-8	Bis[2-(2-chloroethyl thio) ethyl] ether		1% lethality dose is half that of HD. Lesser vesicant than HT. Eye is most sensitive; exposures can result in permanent eye damage.	T is strongly mutagenic.

[a]Although not stored at Pueblo, agent T is included here because it is a component of agent HT and, unlike agent HT, has a CAS number for reference.

The safety standards or control limits outlined in Table 4.21 would be in effect during agent destruction operations; no acute or chronic signs of toxicity are expected in individuals exposed to agent concentrations below these limits. The control limits are the result of extrapolation from the results of laboratory experiments with animals and cell lines (tissues) as well as whatever data are available from human volunteers and victims of munitions factory and battlefield exposures. This extrapolation process is similar to the process used to estimate safe levels of human exposure to food additives, cosmetics, and over-the-counter drugs.

The latent health effect of major concern for exposure to mustard agent is respiratory carcinogenesis. This concern is based on retrospective studies of World War I veterans and World War II poison-gas factory workers from Japan, Germany, and Great Britain (U.S. Army 1988). The general population exposure limit recommended by Department of Health and Human Services (DHHS) is 0.1 µg/m^3, 72-hr average. This concentration has been judged by a panel of experts not to produce a substantially increased lifetime risk of cancer above background levels of cancer in unexposed populations. These background cancer levels result from human exposure to a variety of natural carcinogens (e.g., cosmic rays, natural radiation, ultraviolet irradiation from sunlight, and carcinogenic chemicals in cooked foods) that are impossible to escape, as well as genetic predispositions to cancer and mis-repair during normal cell division, leading to cancer.

Table 4.21. U.S. Department of Defense safety standards for chemical agent exposure and for allowable stack releases used for agent monitoring action limits

Exposures[a]	Concentration of HD in air (µg/m^3)
Agent worker exposure [8-hr time-weighted average (TWA) in a work shift]	3.0[b]
General population exposure	
72-hr TWA[c]	0.1[d]
Ceiling value[e]	3.0[b]
Source emission limit (ceiling value)[e,f]	30.0

[a]No individual would be intentionally exposed to direct skin or eye contact with any amount of solid or undiluted liquid agent, or to solid materials contaminated with agent.

[b]This value also represents the technologically feasible real time detection limit.

[c]Final recommendation by the U.S. Department of Health and Human Services (DHHS) Centers for Disease Control, 53 *Fed. Regist.* 8504–7.

[d]It is recommended that this level of detection be demonstrated and used at all sites where mustard will be transported and destroyed.

[e]Ceiling value normally refers to the maximum exposure concentration at any time, for any duration. Practically, it may be an average value over the minimum time to detect the specified concentration.

[f]Proposed by the U.S. Department of the Army; accepted by DHHS as not posing a threat to human health.

Source: C. A. Hennies, Brigadier General, Director of Army Safety, “Changes to Department of the Army (DA) Toxic Chemical Agent Safety Policy,” a memorandum, February 2, 1990.

Dioxins and furans. The terms “dioxin” and “furan” refer to classes of organic compounds. The polychlorinated varieties of these compounds have caused the most concern in regard to their toxicity. Dioxins and furans are common contaminants in a number of widely used commercial products; some scientists claim that dioxins and furans are trace products of almost all type of combustion that include chlorine and, therefore, are ubiquitous in the environment (U.S. Army 1997). The pathways for human exposure to dioxins and furans would primarily involve inhalation of contaminated particles or ingestion of contaminated food. An evaluation of the state of knowledge regarding dioxin and dioxin-like substances is presented in Appendix G and is summarized below.

The EPA completed a draft reassessment document of dioxin exposure and health assessment in 1994 and submitted it for review. The EPA Science Advisory Board (SAB) conducted a critical review of the document in 1995 (SAB 1995). After the 1995 SAB review, the EPA worked with stakeholders to revise the document. This process is nearing completion (EPA 2001). EPA uses 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) as the basis for analysis and applies Toxic Equivalency Factors (TEF) to address the broad range of dioxin-like compounds having common biological mechanism properties and related responses. Collectively, many of these compounds are referred to as polychlorinated dibenzo-*p*-dioxins (PCDDs) or simply dioxins. The EPA’s Science Advisory Board (SAB) has recently reviewed the EPA’s latest review of the Dioxin Reassessment (EPA 2001). They concluded that the EPA has responded adequately to previous reviews. The conclusion that TCCD is a human carcinogen is disputed by about half of the SAB, but they agree that the EPA has done about all it could with current data.

The EPA's exposure document concluded that the principal pathway by which people are exposed to dioxin-like compounds is through the diet, with the consumption of animal products contributing over 90% of the average daily intake. It is argued that the principal mechanism by which dioxin-like compounds enter the terrestrial food chain is via atmospheric transport and deposition (SAB 1995, EPA 2001). Site-specific estimates of dioxin exposures of PCD await the completion of design, but there is significant experience and measurement history to use as a basis for obtaining approximate dioxin exposures. These will be detailed in the following section.

4.9.3.3 Impacts of baseline incineration

This section will describe the kinds and levels of health impacts that would be anticipated for the incineration alternatives. Health impacts have been assessed for five agent incineration facilities using data accumulated from the first operating agent destruction incinerators. These health assessments have provided increasingly detailed analyses from the first to the fifth, but have resulted in substantially the same low level of calculated risks. The majority of what might be anticipated at PCD will be derived from a discussion of these health risk assessments, with most of the focus on the most recent one performed for the Anniston, Alabama facility. A site specific human health risk assessment (HHRA) for PCD, required in the RCRA permitting process is currently in the protocol development stages for the modified incineration alternative, and this effort will refine the picture of the types and levels of health impacts. In addition to the HHRA, an agricultural assessment is also being formulated to satisfy a requirement of Pueblo County under a "Certificate of Designation," part of the county's permit process for the facility. The HHRA will include direct exposure via inhalation as well as a full evaluation of the ingestion pathway using subsistence farming and fishing for both adults and children at sites of maximum exposure, exposure of nursing infants to dioxins present in their mother's milk when subsistence farming and fishing, and exposure of children to lead. While the agricultural assessment is designed to satisfy Pueblo County's Certificate of Designation, it can have a variety of other uses including indirect validation of the HHRA assessment and verification of continuous safe operations. Within this assessment program, baseline measurements for selected chemicals will be made for soil, sediment, water and for specific food sources grown in the region and identified through a cooperative effort between citizens living or working near PCD, academic institutions and Army personnel. Once a baseline is established for the chemical pollutants of interest, periodic sampling will be performed during operation.

On-post Workers and Residents. Incident-free destruction operation of the baseline incineration facility would include the release of gaseous and particulate emissions containing a variety of chemical substances of concern to human health. Section 4.7.4 presents atmospheric dispersion modeling for expected emissions and shows that no emissions of criteria pollutants would violate air quality standards designed to protect human health. Moreover, analysis of hazardous and toxic substances during operation (Sect. 4.8) indicates that all regulated substances will meet Federal emission limits with the possible exception of mercury. These limits were set to protect human health for all pathways of exposure.

Off-Post Residents...Previous Human Health Risk Assessments at Agent Incineration Facilities. ***Johnston Atoll***. Beginning with the first agent incinerator at the Johnston Atoll (JACADS), efforts have been made to refine our understanding of the effects that agent incinerators have on human health. Operational testing of the individual incinerators at JACADS provided the first full scale information on emissions. These data were used to conduct the first health risk assessment for agent incinerators, which included only the inhalation pathway (U.S. Army Environmental Hygiene Agency 1993). Based on the emissions data from JACADS and anticipated waste feed characteristics, a list of 86 substances of potential concern (SOPCs) that could be discharged to the atmosphere was developed from a total of 160 target constituents evaluated during the RCRA trial burns at JACADS. This list includes substances detected during any single trial burn test run. Emissions of dioxins and furans were included in the JACADS health risk assessments; however, only extremely small quantities of dioxins and furans were emitted from the JACADS incinerators. As indicated in Table 4.22 and 4.23, the measured emissions of dioxins and furans from the various incinerators and furnaces ranged from 0 to 1.48 ng/m^3; this is in the parts-per-trillion range. No *2,3,7,8*-tetrachlorodibenzo-*p*-dioxin was detected. Consistent with all subsequent health risk analyses, all nondetected, regulated SOPCs were assigned emission rates equivalent to the sampling detection limit. Nonregulated SOPCs that were not detected were assumed to be present at ½ of the sampling detection limit. Nondetected agent, agent is assumed to be released at the method detection limit.

The results of the health risk assessment, presented in Table 4.24, show that the total cancer risk, the total chronic noncancer risk, and the total acute noncancer risk resulting from exposure to air emissions from incineration of the three agents [i.e., GB, VX, and mustard (the

Table 4.22. Monitoring results for the liquid incinerator stack during the third OVT campaign at JACADS (incineration of ton containers filled with mustard agent HD)

Pollutant	Maximum stack-gas concentration[a]	Maximum ambient air concentration	Destruction and removal efficiency	Comments
Agent H/HD	None detected	None detected	greater than 99.99995%	Lowest DRE value is given and is based on the method detection level for the specific conditions; it occurred during Run 2.
Dioxins and furans	1.08 ng/dscm	Not calculated	Not calculated	Value given is for Run 3 (poorest performance). The average of 4 runs was 0.040 ng/dscm.
Hydrogen chloride	0.02 lb/hr	Not calculated	Not calculated	Value given is for Run 3 (poorest performance). HCl was not detected during the other runs.
Particulate matter	3.22 mg/dscm	Not calculated	Not calculated	Corrected to 7% oxygen content. The highest value is given; it occurred during Run 2.
Carbon monoxide	18.5 mg/m^3	Not calculated	Not calculated	Four-hour average corrected to 7% oxygen on a dry basis. The highest value is given; it occurred during Run 2.

[a]dscm = dry standard cubic meter.

Source: United Engineers and Constructors, *Results of the Demonstration Test Burn for the Thermal Destruction of Agent HD in the Johnston Atoll Chemical Agent Disposal System Liquid Incinerator*, prepared for the Program Manager for Chemical Demilitarization by United Engineers and Constructors, Philadelphia, Pa., 1993.

Table 4.23. Monitoring results for pollutants from the metal parts furnace stack during the third OVT campaign at JACADS (incineration of ton containers filled with mustard agent HD)

Pollutant	Maximum stack-gas concentration[a]	Maximum ambient air concentration	Destruction and removal efficiency	Comments
Agent H/HD	None detected	None detected	greater than 99.9996%[b]	Lowest DRE value is given; it occurred during Run 1. Proven efficiency was limited by the detection limit of agent in the stack gas[b].
Dioxins and furans	1.48 ng/dscm	Not calculated	Not calculated	Value given is for Run 3 (poorest performance). Average of the 4 runs was 0.50 ng/dscm.
Hydrogen chloride	0.0497 lb/hr	Not calculated	Not calculated	Value given is for Run 2 (poorest performance). HCl was not detected during the other runs.
Particulate matter	10.92 mg/dscm	Not calculated	Not calculated	Corrected to 7% oxygen content. The highest value is given; it occurred during Run 1.
Carbon monoxide	13.0 ppm	Not calculated	Not calculated	Highest value is given; it occurred during Run 1.

[a]dscm = dry standard cubic meter.

[b]Proven efficiency is limited by the detection limit for stack gas and the amount of agent in the feed material. The amount of agent in the feed material in this case was very low. It should therefore be emphasized that this figure is a lower bound that was calculated using the detection limit as the assumed stack gas concentration, and no agent was actually detected in the stack gas.

Source: United Engineers and Constructors, *RCRA Trial Burn Report for HD—Mustard Ton Containers—Metal Parts Furnace at the Johnston Atoll Chemical Agent Disposal System*, prepared for the Program Manager for Chemical Demilitarization by United Engineers and Constructors, Philadelphia, Pa., 1992.

Table 4.24. Summary of health risks from the incineration of mustard agent HD during the third OVT campaign[a]

A. Cancer Risks

Incinerator	Cancer risk probability	EPA level of concern	Risk exceeds EPA level of concern?
Liquid Incinerator			
Average Exposure	2.2×10^{-7}	1.0×10^{-6}	No
Maximum Exposure	5.6×10^{-7}	1.0×10^{-6}	No
Metal Parts Furnace			
Average Exposure	2.9×10^{-7}	1.0×10^{-6}	No
Maximum Exposure	6.2×10^{-7}	1.0×10^{-6}	No

B. Noncancer Risks

Incinerator	Chronic hazard index	Acute hazard index	EPA level of concern	Index exceeds EPA level of concern? (chronic/acute)
Liquid Incinerator				
Average Exposure	0.012	0.009	1.0	No/No
Maximum Exposure	0.025	0.022	1.0	No/No
Metal Parts Furnace				
Average Exposure	0.015	0.010	1.0	No/No
Maximum Exposure	0.030	0.019	1.0	No/No

[a]"Risk" is the total risk calculated from actual concentrations of all pollutants (analytes) detected during the RCRA trial burns. In the risk assessment, agent HD, as well as dioxins and furans, were assumed to be present at concentrations equal to one-half of their analytical detection limit for samples, even when the concentration was otherwise undetectable.

Source: U.S. Army Environmental Hygiene Agency, *Inhalation Risk from Incinerator Combustion Products, Operational Verification Testing—Phase 3 Johnston Atoll Chemical Agent Disposal System*, Health Risk Assessment No. 42-21-M1X6-93, Aberdeen Proving Ground, Md., 1993.

only one of the three which is stored at PCD)] at JACADS were all less than the EPA-established levels of concern for the general public. Both the average and maximum incinerator emission rates were included in the study.

Tooele, Utah; Umatilla, Oregon; Pine Bluff, Arkansas. Three screening human health risk assessments were performed during 1996 and 1997 (A. T. Kearney, Inc. 1966; USACHPPM 1997; Ecology and Environment 1996). The assessments are called screening because they were performed before testing of any of them to obtain actual operating measurements. Two were performed by state departments of Environmental Quality, the third by the Army's Center for Health Promotion. These assessments based effluent release rates on unit emission factors (UEFs) derived from trial burns at JACADS. These UEFs are essentially ratios of released pollutant per pound of feed as measured during trial burns of each munition/agent combination. Unit emission factors are used to normalize SOPC emission rates to a particular waste for each type of waste at each incinerator according to the planned feed rates. The maximum UEF for each SOPC was used to determine the emission rates of compounds in each of the source incinerators at each location.

The assessment at Tooele employed a multi-chemical, multipathway analysis that considered human exposures to chemical emissions from the Tooele facility for a list of 60 constituents of interest. The Tooele facility had 42% of the U.S. agent stockpile compared to PCDs' 9.9%, prior to the beginning of agent destruction; the Tooele inventory of mustard was over twice that of PCD which is slightly greater than 5 million pounds. For the hypothetical adult and child residents, the subsistence fisher and the three types of farmers, the predicted carcinogenic risks for the entire inventory were found to be at or below the level established by EPA screening risk assessment guidelines of 1×10^{-5}. The noncarcinogenic acute and chronic hazard indices met or were below EPA guideline risk levels of 0.25. Similarly, screening health risk analyses were performed for the Pine Bluff, Arkansas and Umatilla, Oregon facilities, each of which had approximately the same quantity of mustard agent as at PCD. These assessments were also based on JACADS unit emission factors, modified to the operational plans and characteristics of the planned facilities. Each of these facilities incorporate features to reduce emissions but the analyses did not take credit for these reductions. These assessments identified more SOPCs than at Tooele. Moreover, the designs of the exposure pathways were more land-use specific and more extensive than the Tooele assessment. In each of these two latter assessments, the conclusions were substantially the same as for Tooele, namely, the predicted risks and hazards were at or below the levels identified by the EPA. Thus, despite increasing attention to inclusion of a greater number of SOPCs and an improved focus on likely environmental food-chain pathways, risk estimates remain essentially unchanged and well within the regulatory target criteria.

Johnston Atoll Trial Burn 1999. More recently, another trial burn was conducted at the JACADS facility to show compliance with the JACADS operating permit for the MPF, which allowed the destruction of agent residue within the munitions and agent-contaminated materials (JACADS 1999). Undrained 4.2 in. mortar projectiles containing agent HD were processed in the furnace. Fuel oil (JP-5) was used as the fuel source for the primary and secondary combustion chambers, which are similar to the proposed facility. The proposed PCD facility however, will use LPG.

Of all the chemicals of concern that were measured, only mercury was suspected to be near or above the emission standards that were in the process of being finalized when the trial burns took place. The United States Environmental Protection Agency (USEPA) has subsequently promulgated the National Emission Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR 63.1203). This rule stipulates emissions standards based on the performance of the Maximum Achievable Control Technology (MACT). This rule and the emission standards contained therein are commonly referred to as the MACT rule and MACT standards, respectively. Incineration-based Chemical Demilitarization Facilities (CDFs) are affected sources under the Hazardous Waste Combustors (HWC) MACT rule.

In order to evaluate the impact of this rule on the existing and proposed CDFs, the Army performed an assessment (U.S. Army, 2001). This assessment concluded that, with the exception of mercury, the incineration options at PCD would be able to meet the standards for all of the listed emissions with the current pollution abatement system design (PAS) that includes a particulate filtration system (PFS). A review of the data taken during the trial burns at the JACAD facility, using the same type of munition as is present at PCD, indicates that the trial burn exceeded the mercury standard in three of four burns. This occurred even though mercury was not detected in feed samples.

The current PAS/PFS designs for both PCD incineration options are expected to remove only about 20 to 40 percent of the feed mercury. These figures are lower than many other HWC systems because feed, combustion, and quenching conditions are expected to produce a relatively high fraction of highly volatile elemental mercury which is more difficult to remove. Removal efficiencies of 20 - 40 percent will not be adequate to reduce mercury levels measured during the JACADS 4.2 inch HD mortar trial burns of 142 µg/dscm down to the standard of 45µg/dscm. Therefore the analysis evaluated options of improved designs for the PAS/PFS as well as options for modified operation. Both design changes and operational modification are thought to be sufficient to reduce the emission rate to below the standard. Currently research is underway at Aberdeen to evaluate trapping efficiencies of alternate types of charcoal and impregnation materials.

As part of the LIC shakedown, trial burns that include mercury spiking are scheduled for the winter 2002 at Anniston, Mercury removal efficiency will be measured using an impregnated activated carbon bed to trap injected mercury samples. There is reason to believe that this system will be effective in meeting the standards because mercury removal efficiencies in similar systems were tested at three Department of Energy incineration facilities during studies to improve the safety of hazardous waste incinerators (MSE 2000). Activated carbon, impregnated with sulfur or iodine, was tested within a fixed bed or as injected powder. All approaches demonstrated the capability for high mercury removal efficiency (>99+%) and the resulting recommendation was to use a fixed bed.

Anniston, Alabama. As part of the licensing process, a Resource Conservation and Recovery Act (RCRA) part B Health Hazard Risk Assessment (HHRA) was completed for the Anniston Chemical Agent Disposal Facility (ANCDF) (U.S. Army 2001). This facility, which has the largest nearby population of any agent depot, is very similar in design to the proposed baseline facility at PCD. The inventory at Anniston contains mustard agent in the same munitions as PCD but Anniston has 2.6 times less total mustard than PCD. However Anniston also has substantial quantities of GB and VX. Because of the similarities of the technologies and the inventory types, and the focus on locations of maximum impact, one would expect similar levels of impacts to human health at the PCD facility as are predicted for the Anniston facility.

The ANCDF HHRA is a multipathway assessment of human health risks that result from stack emissions. The technical approach is designed to provide conservative estimates of human health risk. The HHRA, which included both direct and indirect exposure pathways for a list of 141 constituents of interest, focused primarily on direct and indirect health risks associated with: incinerator/source-specific emissions, startup, shutdown, and upset emissions. In general, direct and indirect human health risks were estimated using USEPA guidance and recommendations. Although the USEPA human health risk assessment protocol was the primary source of methodology, certain approved modifications were made.

Emissions from the facility were estimated based on unit emission factors derived from measurements of input of specific munition/agent combinations and air emissions measured during tests at the JACADS and the Tooele, Utah incineration facility. These unit emission factors were adjusted for differences in operational characteristics. Modifiers were included to account for abnormal combustion conditions that might occur during startup, shutdown, or other production upsets. Emissions during times of nonpeak performance (5% of the time for metals and particulate emissions and 20% of the time for nonmetal emissions) were assumed to be 10 times the level detected during the stack tests. For any of the 141 constituents of interest, the maximum unit emission factor was used out of all tests at either facility, thus attempting to provide a conservative assessment.

The following exposure scenarios were addressed in the Anniston HHRA: a subsistence farmer, a subsistence farmer's child, a subsistence fisher, a subsistence fisher's child, an adult resident, a child resident, and a nursing infant for each adult scenario. These scenarios were evaluated at the location of maximum potential exposure and assuming adult farmer exposures of 40 years and fishers 30 years. For acute inhalation evaluations, an on-site worker and an adult resident with maximum exposures were the individuals selected. An adult subsistence farmer and the child were evaluated for the following pathways: ingestion of soil, homegrown produce, home-produced beef and milk, home-produced pork, home-produced chicken and eggs, drinking water from an impacted surface waterbody, and inhalation of air emissions. An adult subsistence fisher and the child were evaluated for the following pathways: ingestion of incidental soil, homegrown produce, locally caught fish, drinking water from an impacted surface waterbody and inhalation of air emissions. Six different waterbodies were evaluated. An adult resident and child were evaluated for exposures to: ingestion of incidental soil, homegrown produce, drinking water from an impacted surface waterbody and inhalation of air emissions. As recommended by the USEPA, infant exposure to dioxins by ingestion of their mother's milk was evaluated based on the adult of each of the above scenarios. The nursing infant was assumed to ingest maternal milk exclusively; therefore no other exposure pathways were included in this scenario.

The HHRA modeling was based on two operational scenarios: (1) the modified hours scenario in which the deactivation furnace system operated 6000 hours per year while the other two operated at 4800 hours per year, (2) the pollution abatement system carbon filtration system scenario in which a theoretical removal efficiency for mercury emissions is applied while all incinerators are operating at 6000 hours per year. Both operational scenarios produced results that were lower than the target health criteria.

The highest estimated lifetime cancer risk values for any combination of scenarios came from dioxins, furans, mustard agent and 1,2-dibromoethane. All the maximum risk values were less than the EPA target of 1×10^{-5} , and also equal to or less than 1×10^{-6} . Mustard, phosphorus and methyl mercury had the highest estimated non cancer hazards for all scenarios. While most of the estimated hazard indices were less than the criterion of 0.25, for one of the six fisher scenarios the index was equal to the criterion. None of the estimated average daily doses for the nursing infant scenarios were higher than the EPA target of 1% of the average infant background exposure level of 60 pg/kg-day for either of the alternative operational scenarios. For both operational scenarios, the results of lead concentration in the blood level of children aged 0 to 7 years old were less than the target criterion limit of 10 μg/dl blood. It is considered that this level protects children from adverse neurological effects. The maximum calculated concentration of 1.5 μg/dl blood in children was for children between ½ and 1 year of age. Air concentrations of particulate matter for all scenarios were lower than the National Ambient Air Quality Standard.

Conclusions Regarding Past Human Health Risk Assessments. The proposed PCD incinerator would be similar to the Anniston facility as well as all the other agent incineration facilities. PCD has about 2.6 times more mustard agent than Anniston, in the same type of munitions, but Anniston also has GB and VX containing munitions which add to the burden of health risk. (The other incinerators for which HHRAs have been performed had mustard inventories similar to or greater than PCD.) Given the low level of impacts and risks estimated for the Anniston facility and for the other three incineration sites, ample precedent is available to warrant confidence that the target criteria established for safety will be met in the PCD HHRA. While more precise estimates of impact await completion of the PCD HHRA, there is ample experience with incineration to provide confidence that an agent incineration facility could be constructed and operated safely at PCD.

PCD Site-Specific Agricultural Assessment—Human Health Risk Assessment Because of the uncertainties in many aspects of health risk assessments, it has long been a practice at hazardous facilities to establish and maintain an environmental sampling program. Environmental sampling programs are established prior to the facility construction with adequate time to record spatial and temporal variation in the substances of interest before operation of the facility begins. Then, periodic sampling is performed to check on the accuracy of predictions and to demonstrate that the facility is operating according to the design parameters.

The Army will perform an agricultural assessment in fulfillment of a requirement of Pueblo County under a "Certificate of Designation" which is a part of the county's permit process. Agricultural assessments are a part of the Army’s strategy to insure safe operation of agent destruction facilities. The history of such assessments dates back to discussions between the National Academy of Sciences' National Research Council and the Colorado Citizens' Advisory Commission during which members raised concerns about the effect of incinerator emissions on agricultural products grown near incinerator facilities. In turn, the National Research Council recommended that the Army consider collecting soil, vegetation, and water sample from the area around the Tooele Chemical Agent Disposal Facility (TOCDF). At the time these discussions took place in February 1996, TOCDF was built but not yet processing chemical agent. The objective was to collect samples before agent disposal operations began and then compare them to samples taken at regular intervals during disposal operations. The sampling and comparison process would continue through the end of operations at TOCDF. Data gathered from samples would then be analyzed to determine whether the destruction operations caused any adverse agricultural impacts.

The Army's agricultural impact assessment Plan is the result of these discussions. The plan describes approaches for assessing the impact of facility operations on agricultural products. In the event that data from the assessment indicates an increase in any contaminant that could be attributed to the destruction facility, the plan includes methods designed to more directly assess the risk to the human or animal population.

Prior to issuing the plan, the Army held two workshops during which the public was asked to help determine the proper focus and content of the plan. Representatives of the University of Utah, University of Southern Colorado, Colorado State University, various federal and state agencies, and the Army as well as members of the Citizen Action Committees from Colorado, Arkansas, and Kentucky and a number of local residents attended the workshops held in February 1996 and November 1996. The three universities continue to provide independent review and oversight of the agricultural impact assessment process. The Army is currently in the process of identifying the site-specific parameters and locations for soil, sediment, surface water and agricultural product baseline sampling at PCD. Both community and academic assistance is being obtained in developing this sampling program. Baseline data, acquired in approximately eight sampling events, will be compared to data that will be gathered periodically during operations at PCD.

In addition to the agricultural assessment for PCD, the Army is developing a PCD site-specific HHRA for modified incineration. Locations for analyses and the types of analyses to be made will be developed in consultation with local citizens, officials familiar with the local region, and academic professionals. A strategy that incorporates limited environmental sampling at these same locations could provide for a balanced understanding of the final impacts. Thus, if a subsistence farmer is hypothesized at a given location, that location could be sampled to determine if there is a buildup of pollutants within that location, consistent with the risk assessment calculations. It is likely that an agricultural risk assessment could be performed as part of the larger HHRA since there is substantial overlap between the two objectives, and the monitoring program would supplement both analysis objectives.

Compliance with RCRA. If incineration is chosen as the agent destruction technology, the proposed agent incinerator would be required to operate under the ruling of the EPA's Resource Conservation and Recovery Act permitting process for hazardous waste incinerators (FR64 No. 189, Sept. 30, 1999)[2]. New standards found in the ruling were derived after an exhaustive analysis of existing hazardous waste incinerators (in the U.S.) for their emissions and the demographic characteristics of population as a function of location and land use. Based on emissions from what were considered Maximum Achievable Control Technology, emission limits, were determined for mercury, dioxins/furans, particulate matter, semivolatile metals, low volatile metals, hydrochloric acid/chlorine gas, hydrocarbons and destruction and removal efficiency for each specific organic hazardous constituent. These limits were used in analyses of health impacts to determine that the emission limits would be protective of the most sensitive population groups.

4.9.3.4 Impacts of modified incineration

This section contains discussion of potential impacts of incident-free destruction operations at PCD for the modified incineration technology. In June 2000, the Army prepared a description of the modified incineration alternative (U.S. Army 2000). Data and information from that are presented in this section.

Emission characteristics that might influence health impacts. The gas characteristics from the MPF for the modified facility are expected to be similar to that obtained during the 4.2-inch mortar trial burn conducted at JACADS with undrained HD (JACADS 1999). The MPF for the proposed modified facility will be operated under conditions more restrictive than

---

[2]The EPA's air pollution standards for hazardous waste combustors were challenged in Cement Kiln Recycling v. EPA, No. 99-1457 (D.C. Cir. 2001) the full text of which can be found at http://laws.findlaw.com/dc/991457a.html . To set the standards, the EPA had established emission floors, based on maximum achievable control technology. The court found that some floors are not set correctly and stated that the EPA would have to set new floors which reflect a reasonable estimate of the emissions "achieved" in practice by the best-performing sources.

the JACADS 4.2-inch mortar trial burn. The emissions rates for various substances from the energetics treatment furnace are expected to be less than those obtained from the JACADS DFS during the 8-inch projectile GB trial burn (U.S. Army 2000b). The impacts of concern include potential exposure to low–but permitted–levels of chemical agent, criteria pollutants, and products of incomplete combustion (e.g., dioxins and furans).

Gaseous discharge to the atmosphere would originate from the PASs for the two incinerators (MPF and energetics treatment furnace) and from the ventilation system servicing process areas. The incinerators and PASs would be required to meet RCRA and Clean Air Act (CAA) requirements for emissions control. The gaseous emissions from the modified incineration facility are expected to be similar in nature but lower in quantity in comparison with the baseline incineration facility. Due to the reduction in number of furnaces in the modified incineration facility (i.e., no LIC or DUN), the quantity of gaseous emissions that would be discharged to the atmosphere would be less than that of the baseline incineration facility (assuming similar durations of operation). The reduction in total gas flow rate between the baseline incineration facility and the modified incineration facility is estimated to be approximately 30%. Emissions from the modified incineration facility are expected to be less than 10% of those from the 8-in. trial burn for organics, dioxins and furans, and less than 34% for metals. Since mustard agent is not expected to be detected in the gaseous emissions from either the PASs of the modified incineration facility or the baseline incineration facility, there would be no difference in the mustard agent characteristics of the gaseous emissions. These are rough estimates for comparison with the baseline incineration facility because actual data are not available (U.S. Army 2000b).

On-post Workers and on- and off-post residents. From the descriptions of the modified incineration scenario, it is clear that the major difference from baseline incineration where human health is concerned is that there will be less total emissions of non-agent-destruction-associated materials. The same number and type of munitions would be destroyed. No incineration facility has yet been constructed that has the same configuration as the modified incinerator alternative but essentially all of the components have been constructed and operated at several sites.

The safety standards or control limits outlined in Table 4.21 would be in effect during agent destruction operations; no acute or chronic signs of toxicity are expected in on-post workers and residents exposed to agent concentrations below these limits.

Since no acute or chronic signs of toxicity are expected during incident-free routine operations for on-post workers and residents, no acute or chronic signs of toxicity are expected for the off-post population. Given that the same quantity of the same agents would be destroyed in the modified incinerator alternative as the baseline incinerator, essentially the same quantities of toxic byproducts associated with the agents and the munitions will be emitted to the atmosphere. As in the case of the baseline incineration, the effects of modified incineration are expected to be small relative to ambient concentrations of toxic agents such as dioxins and furans and contribute very small total lifetime cancer risks to the ambient background cancer rates. The four previous health risk assessments, all resulted in lifetime cancer risks below the EPA target of $1x10^{-5}$ and the non-cancer Hazard Index of less than 0.25. These sites had between 7.1% and 42% of the nations inventory of agent prior to beginning destruction: Tooele 42%, Pine Bluff 12%, Umatilla 11.6%, and Anniston 7.1%. The Pueblo site contains 9.9%. Given the increasing degree of completeness of the sequence of HHRAs, and their similar outcomes, it would be expected that the HHRA for PCD modified incineration would yield similar results.

However, regardless of which disposal alternative is chosen for PCD, an HHRA specific to the PCD will be performed. In fact HHRAs are currently underway for neutralization and incineration alternatives at PCD. Some of the specifics of the HHRA are discussed in Sect. 4.9.3.3. If incineration is chosen, in addition to the HHRA, there will be an agricultural assessment program established provide measurements of environmental samples before and during operation. These samples can help to verify the continuous safe operation of the facility.

4.9.3.5 Impacts of neutralization

The results from the Army experience including design, construction and operations of one or more pilot test facilities are presented in this section.

Over the past several years, the ACWA program has narrowed the non-incineration alternatives for PCD to the two neutralization alternatives highlighted in this document and has supported the development of engineering design packages and related experimental tests of components of these two alternatives. The National Research Council was asked to review these technologies and the most recent review has determined that both alternatives can result in acceptable processes (NRC 2001). Based on the results of demonstration tests and the engineering design package, the neutralization/biotreatment is thought to be able to provide an effective and safe means of destruction for the assembled chemical weapons stored at PCD. However there were some process steps that remained to be demonstrated at the time of the NRC report. The report noted that HD was effectively destroyed but that some process steps, including removal of energetics from munitions, had not been tested up to the time of the report. Similarly, the results of the demonstration tests, the engineering design package and available data for the neutralization/SCWO alternative suggest that this alternative can provide effective and safe destruction of assembled chemical weapons at PCD. However, the NRC report cautioned that prolonged operability of the SCWO system as designed will require extensive maintenance. Since neither alternative has been operated as an integrated process, a prolonged period of systemization will be necessary to resolve integration issues as they arise. Both alternatives have gaseous effluents that are continuously emitted and there is some potential for release of toxic materials. Proposed effluents for the neutralization alternatives based on limited measurements and calculations are enumerated in Appendix I.

The ACWA program separately from the NRC report, has evaluated the two alternatives for impacts to workers and residents and determined that impacts would be extremely small (ACWA 2001). Routine operations of the facility and minor fluctuations might expose workers or the public to small quantities of hazardous materials. The facility would be engineered to limit such exposures to the greatest degree possible. Measures would include pollution abatement systems similar to the baseline technology, water recovery and recycling, remote handling of munitions and PPE for workers. Risks for cancer for both alternatives was judged to be much less than 1 in 1 million. Non-cancer risks determined by the hazard index were much less than the target of 0.25.

4.9.4 Impacts of No Action

Impacts from Routine Continued Storage Activities. Small, but well understood risks to workers are associated with maintenance of the stockpile. Army procedures are designed to ensure the safety of the stockpile workers; therefore no significant adverse impacts to human health are likely during continued storage.

4.9.5 Cumulative Impacts

There are no past, present or reasonably foreseeable on-post actions that would combine with any of the four alternatives to cause cumulative adverse health impacts to the on-post workers and residents, and the off-post population (see Sect. 4.8.7 and 4.8.8 for discussion). Health impacts from all alternative technologies are anticipated to be so small that contribution to cumulative effects with off-post industry would be extremely small.

4.10 NOISE

The Noise Control Act of 1972, along with its subsequent amendments (Quiet Communities Act of 1978, *United States Code*, Title 42, Parts 4901-4918), delegates to the states the authority to regulate environmental noise and directs government agencies to comply with local community noise statues and regulations. The state of Colorado has quantitative noise-limit regulations. The maximum permissible noise limits for the various classes of source areas under the Colorado Noise Abatement Law are listed in Table 4.25.

Table 4.25. State of Colorado regulations on maximum permissible noise levels

	Maximum permissible noise level[a] [dB(A)]	
Zone	7 a.m. to 7 p.m.[b]	7 p.m. to next 7 a.m.
Residential	55	50
Commercial	60	55
Light industrial	70	65
Industrial	80	75

[a]At a distance of 25 ft or more from the property line. periodic, impulsive, or shrill noises are considered a public nuisance when such noises are at a level of 5 dB(A) less than those listed.

[b]For a period not to exceed 15 min in any one hour, the noise level may be exceeded by 10 dB(A).

Source: Colorado Revised Statutes, Title 25 on Health, Article 12 -103 on Noise Abatement.

Loudness is related to the magnitude of the pressure fluctuations, or sound pressure level (SPL), which is measured in units of Bels, after Alexander Graham Bell who did pioneering research on sound propagation. Because the Bel is a rather large quantity, it is conventional to measure SPL in tenths of a Bel, or decibels (dB). The threshold of human hearing is, by definition, zero dB; background levels at a recording studio are, ideally, around 15 dB; conversational speech is around 60-65 dB at the location of the listener, and a jet takeoff can be in the 120 dB range at a distance of about 30 m (100 ft) from the runway. The threshold of pain, where the brain receives a definite signal to reduce the SPL or run the risk of damage to the auditory system, begins at around 130 dB for most individuals. Because SPL is reduced by about 6 dB for each doubling of distance from a source, it is important to specify the distance from the source at which a measurement of SPL is made. It is also important to specify an averaging method in order to differentiate between relatively constant noise and occasional or impulsive noise. Noise from construction activity is reasonably continuous over an 8-9 hour work day; therefore, the measures of impact would apply to long-term (day-night) averages. The values used in this assessment correspond to day-night sound pressure (loudness) levels (L_{dn}).

Sound typically occurs over a wide spectrum of frequencies. For many types of sound measurement, these frequencies are weighted (some count more, some count less) to determine the decibel level. The so-called “A weighting” was developed to approximate the way in which the human ear responds to sound, and this weighting, expressed as dB(A), applies to the values given below.

The EPA guideline recommends a day-night sound level of 55 dB(A) or less to protect the public from activity interference and annoyance in typically quiet outdoor and residential areas (EPA 1974). Maintaining relatively continuous noise below this level will also protect against hearing loss, although less stringent requirements are typically set for that purpose.

4.10.1 Existing Environment

PCD is surrounded on three sides (north, east, and west) by undeveloped ranchland used for grazing; therefore, few noise sources exist in those directions. The major noise sources in the area surrounding PCD include railroad and highway traffic to the south, the Transportation Technology Center to the North, and aircraft traffic in and out of the Pueblo Memorial Airport. Currently, no major noise-producing activities exist on site, and no on-site noise monitoring data are available. In the general PCD area, the background environment is typical of rural areas, and residual sound levels would be approximately 30 to 35 dB(A) (Liebich and Cristoforo 1988). Near the southern boundary of the PCD site, the background acoustic environment may be higher, about 40 to 45 dB(A), because of the highway and railroad traffic.

Measurements made near the north boundary of PCD, during November 1999, indicate that minimum background noise levels were around 34 dB(A) during mid-afternoon (White 2000). The average nighttime background noise level was around 25 to 30 dB(A), depending on wind conditions.

An investigation of the noise environment at PCD (U.S. Army Environmental Hygiene Agency [USAEHA] 1990) indicated that Areas A, B, and C are classified as acceptable for land uses that are noise sensitive (i.e., the ambient L_{dn} is less than 65 dB(A), which is compatible with residential or institutional development). Currently, the only residence or sensitive noise receptors (e.g., hospitals, schools, park) in the immediate vicinity of PCD are the on-post residences located in the Administrative Area and Hi-Pardner Park, next to PCD's main gate. The off-post residence closest to Munitions Storage Area A is located about 0.5 mile north of the PCD boundary. The closest population centers with schools or town infrastructure are North Avondale, Avondale and Boone, which are about 0.4 mile, 1.6 miles and 1.5 miles from the south boundary of the PCD, respectively.

4.10.2 Noise Sources

4.10.3 Impacts of Construction

The noise impacts of construction would not be significantly different between any of the incineration or neutralization alternatives.

Construction and associated activities would result in the generation of noise due to the operation of vehicles and heavy equipment. Such equipment typically generate noise levels in the range of 77 to 90 dB(A) at a distance of about 50 ft from the source (EPA 1978). Sound energy attenuates as it spreads over an ever-increasing area while moving away from its source, leading to a decrease in sound pressure levels of 6 dB for each doubling of distance from the source (DOD 1978). At the nearest site boundary, about 0.62 mile from the nearest edge of the proposed construction activity, noise would be reduced by about 36 dB(A). Absorption of sound energy by the atmosphere would further reduce the noise level to below 54 dB(A) at the nearest site boundary. Fifty-five dB(A) is the EPA and state limit for daytime noise in residential areas (no construction is expected at night). Noise levels would be appreciably less at the nearest residence, about 2970 ft further away. Noise impacts from construction activities at the site are thus expected to be minimal at residences near PCD.

4.10.4 Impacts of Operation

The noise impacts related to operation of any of the incineration or neutralization alternatives would not be significantly different.

Operation of a chemical munition destruction facility would result in the generation of noise. The only operating incineration facility of the kind proposed for PCD, with a non-workforce surrounding population, is located at Tooele Army Depot, Utah; sound measurements at and near that facility indicated levels as high as 68 dB(A) (see description of dB(A) in Sect. 4.11.1) at a distance of 245 ft from the pollution abatement system (EG&G Defense Materials, Inc. 1997). However, measurements from other locations indicated that much of that sound energy was absorbed by nearby buildings before propagating much further. Absorption of sound energy by buildings and other structures within a facility greatly reduces noise levels beyond the facility.

Experience from the baseline incineration facility near Tooele indicates that heating, ventilation, and air conditioning (HVAC) equipment and generators that are located outdoors (i.e., not enclosed) can be a major noise source, especially if the pieces of equipment involved are arranged in a straight line and located near the outside edge of the facility. Sound pressure levels as high as 57 dB(A) were measured as far as 820 ft from the Tooele facility. Assuming the same noise level 820 ft from the proposed location of a chemical munition destruction facility located at PCD, the noise level at the nearest site boundary [about 0.62 mile north of the proposed facility location] would be less than 45 dB(A). This is well below the 55 dB(A) level which, if not exceeded, would prevent activity interference and annoyance (EPA 1978). Therefore, noise levels from operation of a destruction facility would not be expected to impact any off-site location. At the nearest residence, the maximum outdoor noise level expected would be less than 40 dB(A), which may or may not be audible, and would not be expected to have any impact in terms of activity interference and annoyance, or on hearing ability.

4.10.5 Impacts of No Action

If no action is taken, sound levels would be expected to remain at their present low levels. Near the northeastern part of the site boundary, noise levels have been typical of outdoor environments far from any concentrated human activity, such as population centers or roads. In such environments, sounds are typically dominated by insects, birds, and interaction of wind with local vegetation. Typical SPLs just north of PCD have been measured at around 30 to 40 dB(A) (Sect. 4.10.1); these levels are lower than those of a typical library [around 45 dB(A)].

4.10.6 Cumulative Impacts

With Other On-post Actions, Typically, SPLs decrease at a rate of about 6 dB (regardless of frequency weighting) for each doubling of distance from the source. Therefore, two facilities would have to be in close proximity for their cumulative noise impacts to be substantially greater than either of their individual impacts; however, this is likely to be the case if two agent-destruction facilities operate simultaneously near Munitions Storage Area A.

The SPLs from several noise sources are not additive; instead, SPL increases by 3 dB (regardless of frequency weighting) for each doubling of sound energy. This is consistent with experience; sounds are dominated by the loudest source. If other on-post actions are sufficient to double the sound energy, the corresponding increase of 3 dB(A) would have little effect on the noise perceived at any off-site location.

With Other Off-post Actions, The distance between the proposed facility (or facilities) and any appreciable off-post source is sufficient that the 6 dB reduction of SPL with distance from any such source would reduce its SPL to a level that would be small compared with that from the proposed facility (or facilities). Therefore, the contribution of such sources to cumulative effects would not be appreciable. This reasoning also applies to locations near any off-post noise source, which would be far from any of the incineration or neutralization facilities being considered for PCD.

4.11 VISUAL RESOURCES

4.11.1 Existing Environment

PCD is located in a rural area where the surrounding landscape is primarily rolling, open pastureland used for livestock grazing. There are signs of development surrounding PCD-ranch homes and buildings, TTC facilities, U.S. Highway 50, numerous state and county roads, rail lines, electric transmission lines--but the character of the area remains rural and open, as is typical of eastern Colorado.

Despite this rural setting, the visual character of much of PCD itself is industrial. Although there are some vast undisturbed spaces and a few small water bodies on the installation, a large portion of PCD has been disturbed by the construction of buildings, storage igloos, roads, rail lines, utility structures and corridors, and fences. It is likely that this industrial appearance would not change significantly given the “large warehousing and distribution facilities” proposed in the *Reuse Development Plan Update* (PDADA 2000a).

Although the proposed site of the PCD chemical agent destruction facilities has not been developed for industrial use in the past, the *Reuse Development Plan Update* allocates more than 5,200 acres in and around the site for chemical demilitarization. In addition, the site is adjacent to the existing chemical weapons storage area, with its network of igloos, roads, electric power lines, and fences.

4.11.2 Visual Character of the Chemical Agent Destruction Facility

Regardless of the technology selected, the PCD chemical agent destruction facilities would have a visual character typical of large, modern industrial facilities. The facility footprint for both incineration and neutralization technologies would be about 20 acres, with up to 85 acres of total land disturbance when utility corridors and running routes are included. In terms of visual impacts, the primary concern would be with those structures that would be most visible to off-post viewers: the new electrical transmission lines and the emissions stacks. Although the new transmission lines would have a similar visual appearance regardless of the destruction technology, there would be differences among the alternative technologies in stack height. Baseline and modified incineration would each require a maximum stack height of 140 ft. The tallest stack required for neutralization with either SCWO or biotreatment would be about 100 ft.

4.11.3 Impacts of Construction

The visual impacts of constructing chemical agent destruction facilities would be typical of those associated with constructing most large industrial facilities. Land clearing with heavy equipment would create dust. Construction of the munitions destruction building, the stacks, and the other project buildings and utility structures would be visible to some off-post viewers. However, it is expected that the visual impacts of construction would not be significant because (1) most construction would occur on PCD in areas not highly visible to off-post viewers, (2) off-post construction of electric transmission lines would occur in areas used primarily for livestock grazing, and (3) the visual impacts of construction would be intermittent and temporary.

4.11.4 Impacts of Operation

The visual impacts of operating chemical agent destruction facilities would result primarily from the physical presence and visibility of project structures. Baseline or modified incineration would have the most highly visible on-post structures, with at least one 140-ft stack. Facilities for neutralization with SCWO or biotreatment would be less visible because of their shorter stack height. The new transmission lines would be equally visible for all technologies. It is expected, however, that the visual impacts of operations would not be significant because (1) most of the facilities would be located in or near areas of PCD where industrial development has already occurred, (2) most of the facilities would be located in areas of PCD that are not highly visible to off-post viewers, and (3) the off-post transmission lines would be located in areas used primarily for livestock grazing.

4.11.5 Impacts of No Action

Under the no action alternative, there would be no change to the existing visual character of PCD.

4.11.6 Cumulative Impacts

Construction and operation of chemical agent destruction facilities at PCD could combine with other on-post and off-post actions to create cumulative impacts on the rural visual character of the area. Other on-post actions that could contribute to cumulative impacts include the industrial land uses proposed in the *Reuse Development Plan Update* (PDADA 2000a). However, it is not likely that these uses and the chemical agent destruction facilities would combine to create significant cumulative impacts because they would occur in or near areas where industrial development has already occurred and they would not be highly visible to off-post viewers. Off-post actions that could contribute to cumulative impacts include the continued development of TTC facilities north of PCD. This development, combined with the existing industrial development on PCD and the proposed chemical agent destruction facilities, would represent a moderate cumulative impact to the area's visual character.

4.12 GEOLOGY AND SOILS

This section describes the existing geologic and soil resources in the vicinity of PCD and presents an assessment of the potential impacts of construction and operation of a chemical munitions destruction facility on those resources.

4.12.1 Existing Conditions

PCD is situated on a terrace in the western part of the Colorado Piedmont section of the Great Plains physiographic province. The gently rolling topography at PCD ranges in elevation from about 4810 ft above mean sea level (MSL) at the northern boundary to about 4846 ft above MSL at the southern boundary (Chafin 1996).

The upland alluvial terrace deposits underlying PCD consist of interlayered sand, gravel, and clay layers that were deposited during the Pleistocene Epoch (Table 4.26) (Watts and Ortiz 1990). Across the installation, these alluvial deposits range in thickness from 95 ft (Chafin 1996). They unconformably overlie the Pierre Shale, a thinly bedded, dark gray to black shale/sandy shale unit of Upper Cretaceous age. The Pierre Shale, which is approximately 1200 ft thick in this area, is characterized by an irregular surface that was shaped by erosion before deposition of the alluvial terrace deposits (Watts and Ortiz 1990). Irregularities in the surface of the Pierre Shale account for the wide variability in thickness of the alluvial deposits at PCD. Weathered exposures of the Pierre Shale bedrock occur along the courses of Chico and Haynes Creeks (Scott et al. 1978), but these contacts are partially obscured by soils (Watts and Ortiz 1990). Economic geologic resources beneath the PCD are limited to sand and gravel deposits. Mineral resources are not known to be present.

Table 4.26. Soil associations observed at Pueblo Chemical Depot

Association	Soil type	Characteristics
Stoneham-Adena-Manzola	Sandy to clayey loams that form in loess and in loamy and clayey alluvium	Deep, well drained Slow or moderate permeability High available water capacity Medium runoff Moderate potential for erosion
Olney-Vona	Sandy loams and loamy sands that form in eolian sands	Deep, well drained Moderate to rapid permeability High available water capacity Slow runoff High potential for wind erosion
Limon-Razor-Midway	Silty clays, silty clay loams, clay loams, and clays that form in materials weathered from shale	Shallow to deep, well drained Slow permeability High to very low available water capacity Rapid to medium runoff Moderate to severe potential for erosion
Arvada-Keyner	Sandy to clayey loams that form on terraces in alluvium derived from mixed sedimentary rocks	Deep, well-drained Very slow permeability High available water capacity Slow runoff Slight potential for erosion
Valent	Loamy sands and sands that form in eolian sands	Deep, excessively well drained Very rapid permeability Low available water capacity Slow runoff Severe potential for wind erosion
Las Anima-Glenberg-Apishapa	Fine sandy loams and silty clays that form in alluvium on flood plains	Deep, somewhat poorly to well drained Slow to moderately rapid permeability Moderate to high available water capacity Slow runoff High potential for erosion

Source: Adapted from USDA (1979).

Seismicity. The nearest recorded earthquake to the PCD that produced damage occurred on January 6, 1979 (Kirkham and Rogers 1981). This earthquake had a center at Divide, Colorado, approximately 63 miles from the site. It had an intensity of 5.0 (small objects were displaced, pictures moved).

On the U.S. Army's behalf, Jacobs Engineering Group, Inc., and URS/John A. Blume & Associates jointly prepared a comprehensive assessment of the earthquake hazards at PCD. The results of this assessment and comprehensive discussions of regional geology, tectonics, and earthquake history are presented in a report issued by the U.S. Army (U.S. Army et al. 1987). On the basis of this assessment, it was determined that the maximum earthquake that could be anticipated to affect PCD would most likely occur on the Fowler Fault. A local magnitude of M = 6.1 (equivalent to m_b = 5.7) was estimated as the maximum earthquake magnitude for the Fowler Fault. (M [moment magnitude] represents the strength of an earthquake based on the concept of seismic moment. Mb [body wave magnitude] is a measure of the energy released by an earthquake). An earthquake of this magnitude would produce a peak ground acceleration of 0.21 g at the PCD. The earthquake duration was estimated to be 8 seconds. Impacts to buildings from an earthquake of this intensity would be damage to masonry, with a potential for a partial building collapse.

A recent probabilistic analysis was performed for the Army Chemical Disposal Facility at Pueblo, Colorado. This study indicated that the peak ground acceleration associated with the Cheraw and Sangre de Cristo Faults and the Great Plains and Denver Basin Source Zones would be approximately 0.1 g for an earthquake that would have a 100% probability of occurring once in 1,000 years. A peak ground acceleration of approximately 0.23 g was estimated for an earthquake that would have a 100% probability of occurring once in 10,000 years (Benjamin and Geomatrix 1996). This value is in good agreement with the 0.21-g value previously estimated by the U.S. Army et al. (1987). In the Benjamin and Geomatrix (1996) study, however, the Fowler Fault was not included in the analyses because of recent data that showed the absence of a bedrock fault with significant displacement in the location of the postulated feature. The nearest capable fault for this study was the Cheraw Fault, described above.

According to Army Technical Memorandum 5-809-10 (U.S. Army et al. 1992), PCD is located in seismic probability zone 1, a zone where minor earthquake damage may be expected to occur at least once in 500 years (or a 10% probability of occurrence in 50 years). Seismic design criteria are provided in this manual, in accordance with recommendations of the Structural Engineers Association of California, American Concrete Institute, American Institute of Steel Construction, and the International Conference of Building Officials. Designs in a report on the seismic fragility of structures and equipment for the U.S. Army Pueblo Chemical Agent Disposal Facility in Pueblo, Colorado, were based on an earthquake that had a 100% probability of occurring once in 100,000 years (Shah and Reed 1996). The peak ground acceleration for this event was estimated to be 0.403 g.

Soils. Soil types at PCD vary (Table 4.26 and Fig. 4.9) and are grouped into several soil associations on the basis of shared characteristics (U.S. Department of Agriculture [USDA] 1979). Within the areas at PCD designated for chemical demilitarization activities, the soils belong to the Valent, Olney-Vona, Arvada-Keyner, and Limon-Razor-Midway Associations. The engineering properties of these soils are variable and must be accounted for in the design of any facilities built in these areas. Soils in Areas B and C have been previously disturbed. Soils in Area A are relatively undisturbed except along the Munitions Storage Area A fence

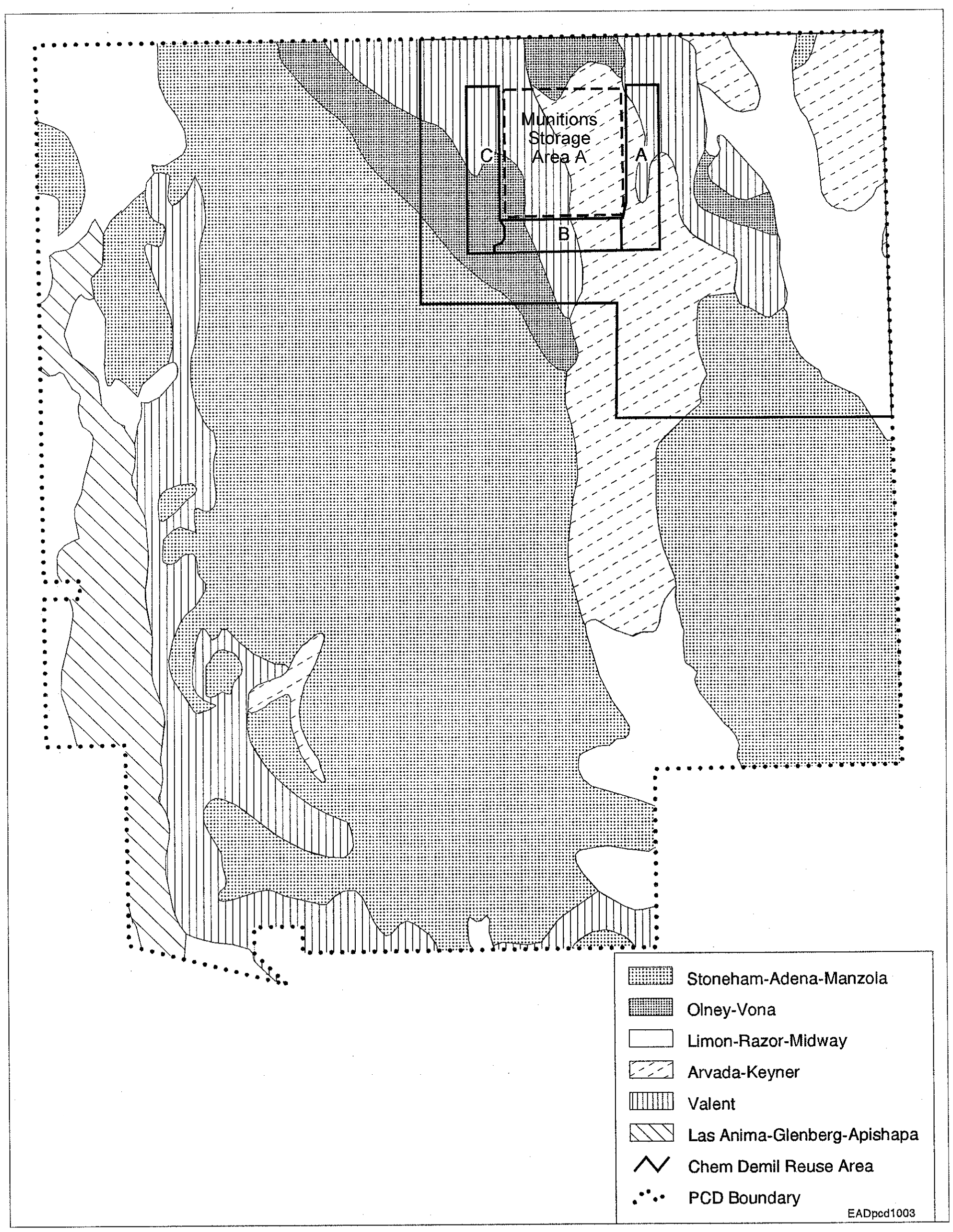


Figure 4.9. Soil Types at the Pueblo Chemical Depot (Adapted from USDA 1979).

line and boundary road. Because the terrain is relatively flat, minimal soil disturbance is required for facility construction. Excavated soils for utility corridor construction will be used as trench backfill.

4.12.2 Impacting Factors

Environmental impacts could occur to soils and economic geologic resources (e.g. aggregate) during construction and operation of the alternative facilities. Impacts could result from planned soil excavation activities for the alternative facilities and the consumption of sand and gravel resources for use in roadbeds, infrastructure trench bedding material, and as construction materials. Impacts could also result from the unavailability of resources located beneath the site. Economic geologic resources (e.g., aggregate) is widely available in the PCD area, and impacts to these resources is considered to be negligible. Similarly, because no known mineral resources are known to exist beneath the site, and they have already been unavailable for nearly 60 years, impacts to this resource are also considered to be negligible. Thus, impacts to economic geologic resources and mineral resources will not be discussed further.

4.12.3 Impacts of Construction

This section discusses the impacts to geology and soils from the construction of a chemical munitions destruction facility at PCD. There would be no significant differences in impacts between the four alternative technologies being considered. The discussion includes both direct and indirect impacts.

Direct environmental impacts to soils would limited to the loss of the soil resource because of physical alterations to the existing soil profile. These alterations indirectly lead to a reduction in the soil's ability to support plant and animal life and may possibly lead to changes in windborne erosion patterns, changes in surface water drainage and erosion patterns, and changes in infiltration characteristics.

Indirect impacts to land use were described in Sect. 4.2. Impacts concerning the loss of vegetation and habitat are described in Sect. 4.16; and windborne impacts were described in Sect. 4.7. The assessment for the loss of the soils resource compares the amount of soils to be lost at the proposed site with the amount of similar soils resources available in the PCD area. As discussed below, direct impacts to the loss of the soils resource would be small.

Soil Disturbance and Erosion. Up to 85 acres of land could be disturbed for the facility site and associated access roadways and utility corridors. This amount of land constitutes much less than 1% of area of the PCD installation. Soils disturbed for utility corridor trench installation would be used as backfill and would not be lost. Topsoil would be removed and temporarily stockpiled for later use as the final backfill cover. Excess disturbed soils (e.g., from the sewage lagoon, and new substation) would be distributed in adjacent areas, contoured to match the existing topography to the extent possible and seeded in native vegetation. It is anticipated that only minimal clearing, grubbing, and earthwork would be required because vegetation is sparse and the land is relatively level. The disturbed soil type is not unique to the PCD installation or the surrounding region, and alteration of such a small amount of soil is considered to have an accompanying small impact to the soils resource. Surface water drainage, water erosion, and infiltration impacts are described in Sect. 4.15.

Soil Contamination. Spills of construction liquids (e.g. diesel fuel, hydraulic oil, paint, solvents) could locally contaminate soils leading to the loss of that resource. Implementation of standard construction safety practices, spill cleanup containment training, and cleanup measures would mitigate the loss of the soils resource.

Paleontology. Paleontological resources are not expected to be encountered in the course of construction, due, in part, to the relatively minor amount of excavation required and the absence of such resources in previous construction activities at PCD. Should such resources be encountered, construction would be halted until the nature of the resource can be determined. Alternate construction locations would be identified if warranted.

4.12.4 Impacts of Operations

There would be no significant differences in operations impacts between the four alternative technologies being considered for destruction of the chemical munitions stored at PCD.

Soils. No soils would be disturbed during operation; thus, enhanced soil erosion would not be sustained. No soil contamination would be incurred under incident-free operation.

4.12.5 Impacts of No Action

Neither soils nor mineral resources would be adversely impacted by continued storage of chemical agent at PCD. Controls are in place to minimize soil erosion, and procedures in place to cleanup chemical spills.

4.12.6 Cumulative Impacts

With Other On-post Actions. On-post activities are generally limited to cleanup and decommissioning activities which are largely located in the southern portion of PCD. The locations of the proposed facility are sufficiently removed from these activities that no cumulative impacts to soils or mineral resources, are foreseen.

With Other Off-post Actions. Impacts to other off-post actions are limited to the availability of mineral resources for construction use. Such resources are in sufficient supply in the region that cumulative impacts are considered to be small.

4.13 GROUNDWATER

This section describes the existing groundwater resources in the vicinity of PCD and presents an assessment of the potential impacts of the construction and operation of a facility to destroy the mustard-filled chemical munitions stored at the depot.

4.13.1 Existing Conditions

4.13.1.1 Geohydrology

This description of the geohydrology of PCD is compiled mainly from the 1996 U.S. Geological Survey (USGS) report (Chafin 1996). The USGS delineates two separate aquifers on the PCD site: (1) the terrace alluvial aquifer that underlies the majority of the site and (2) the Chico Creek aquifer that is located downgradient and west in the Chico Creek Valley.

The Chico Creek aquifer will not be affected by the proposed activities because it is separated from the main PCD post area by the incised drainage of Chico Creek. Therefore, this discussion focuses on the terrace alluvial aquifer because it is the only aquifer that can be affected by the proposed action. A third aquifer, the Arkansas River Valley aquifer, is located in the Arkansas River Valley south of PCD. This aquifer is significant and supplies agricultural irrigation wells, many of which are located downgradient of PCD. According to Ebasco Environmental (1990) the terrace alluvial aquifer located under PCD and the Arkansas River Valley aquifer are not hydraulically connected. However, Rust, Inc. (1997) found some connection between aquifers in a narrow alluvial channel near Unnamed Creek in the south central portion of PCD.

Hydraulic conductivity in the terrace alluvial aquifer, measured in a combination of pump and slug tests, covers a wide range, from 0.4 to 400 ft/d (Chafin 1996). Under the assumption that porosity is 0.2, the estimated groundwater flow velocity ranges from 0.02 to 3 ft/d; the median is 0.8 ft/d (Chafin 1996). In locations near the landfill, located in the southeastern area of the depot, velocities as high as 11 ft/d have been estimated (Chafin 1996). The estimated hydraulic gradient ranges from 0.003 to 0.02 (Chafin 1996). Because the potential evaporation of 48 in. exceeds the precipitation of 12 in. by a large margin, potential recharge to the groundwater aquifer from rainfall on PCD is low (Chafin 1996). Rice et al. (1989) argue that under these types of conditions, recharge is approximately 1% of precipitation, or, in this case, 0.1 in. per year. Water, and any potential contamination, may migrate through thin, highly permeable layers in the terrace alluvium at velocities near the upper range of the estimates provided. In addition, in areas where eolian sands cover the surface, infiltration rates could be higher.

The terrace alluvial aquifer at PCD consists of interlayered sand, gravel, and clay from a Pleistocene deposit. According to Chafin (1996), drillers logs indicate that the alluvium is 1 to 10 ft of sandy or silty clay, clayey or sandy silt, or clayey or silty fine- to medium-grained sand underlain by interbedded layers of poorly sorted, often clayey and gravelly, fine- to coarse-grained sand. Chafin (1996) indicated that the seven bores drilled to characterize the terrace alluvial aquifer penetrated 40 to 95 ft of alluvium before reaching bedrock. The terrace alluvial aquifer is underlain by an almost impermeable Pierre Shale (bedrock), which is 1200 ft thick (Watts and Ortiz 1990). The shale effectively isolates the surface terrace alluvial aquifer from other groundwater resources in the area. The shale also isolates deeper groundwater aquifers from any impacts resulting from the proposed activities. The uppermost significant water-bearing formation below the Pierre Shale is in the Dakota Sandstone, at least 2200 ft below the surface (Chafin 1996).

Below the terrace alluvial aquifer, the bedrock surface, shown in Fig. 4.10, slopes about 0.5% to the south (Ebasco Environmental 1990) and is regular in the northern portion of PCD.

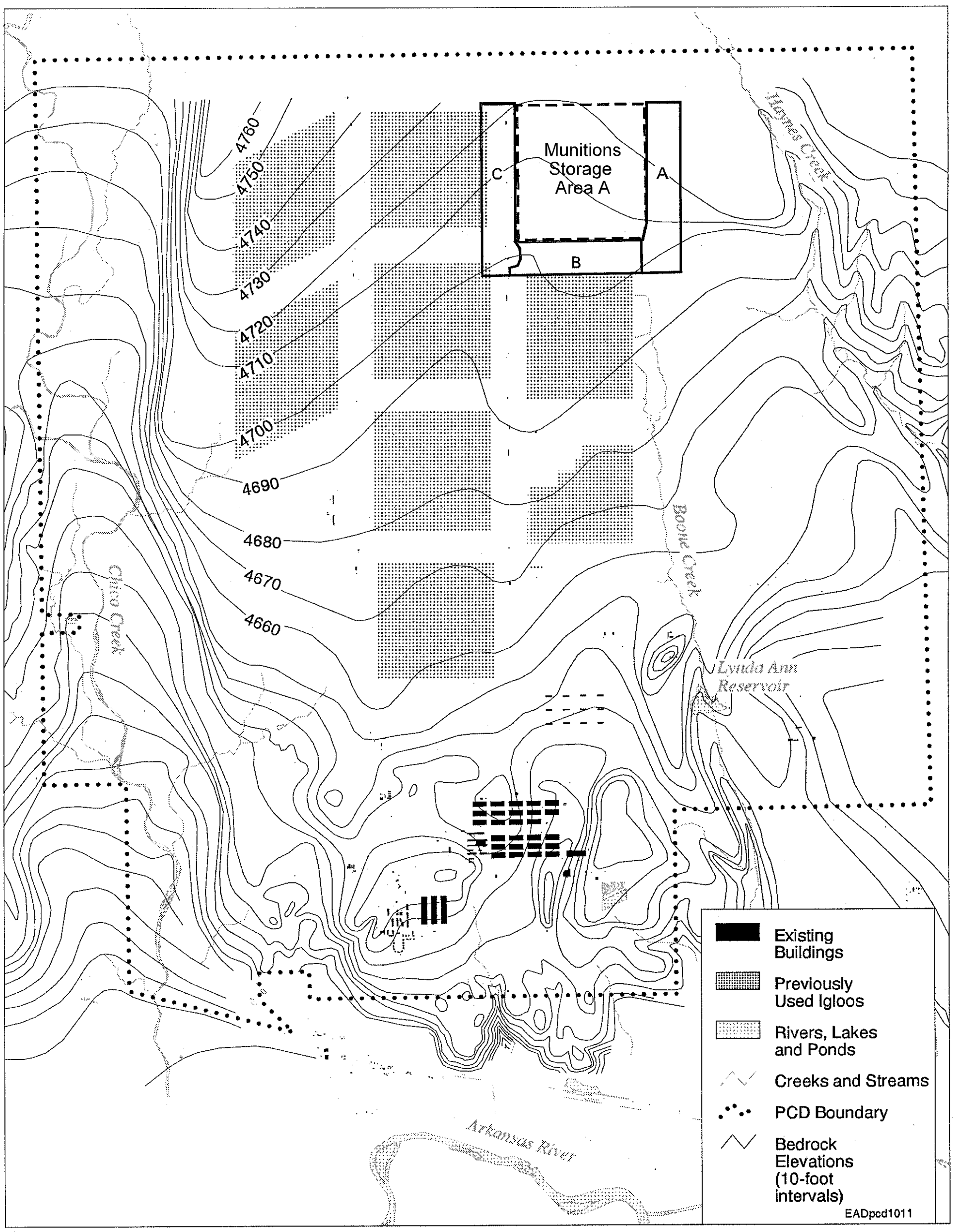


Fig. 4.10. Bedrock Surface Elevations at Pueblo Chemical Depot.

The bedrock surface in the southern portion of PCD is irregular and has a series of hills, troughs, and ridges (Chafin 1996). The bedrock surface is inferred from limited data. The saturated thickness of the aquifer ranges from 0 to 45 ft. A bedrock trough starts near the center of the northern boundary and tends in a southern direction through the center of PCD. Four water supply wells are located in this trough because of the increased saturated thickness of the aquifer in this region (Chafin 1996).

The terrace alluvial aquifer is bounded on the west by a steep scarp caused by Chico Creek downcutting into the terrace deposits. On the south, it is bounded by the Arkansas River Valley, which has formed a similar scarp. The Boone Creek drainage, near the center of PCD, effectively separates the terrace alluvial aquifer into two hydrogeologically distinct units. The head of the Boone Creek drainage contains a bedrock alluvium contact spring located just south of Munitions Storage Area A (Fig. 4.11). The eastern boundary of the terrace alluvial aquifer is formed by a scarp from the downcutting of Haynes Creek. Where the terrace alluvial aquifer does not encounter an exposed bedrock-alluvial boundary, the aquifer is bounded by local bedrock highs that reach above the groundwater table.

Figure 4.11 shows the groundwater surface profile, and the location of water supply wells at PCD. These wells will be discussed in Sect. 4.14.1.2, Groundwater Quantity to follow. Groundwater flow generally follows the surface slope in a southerly direction. However, in the southwest area of PCD, flow directions are complex and dictated by the irregular bedrock surface and surface drainage features that cut into the terrace alluvial deposit. In addition, there are bedrock outcrops, and a series of seeps and springs discharge at the exposed bedrock-alluvial contact.

4.13.1.2 Groundwater quantity

The source for groundwater under PCD is primarily from underflow from the north (U.S. Army 1982). Estimated flow volumes range from 400 acre-ft/year (Chafin 1996) to 900 acre-ft/year (U.S. Army 1984). Both of these studies assume that little or no recharge takes place on PCD, even though the surface soil is generally permeable. The studies attribute this lack of infiltration to low precipitation and high evapotranspiration. Because the aquifer terminates on the scarps and slopes that surround PCD, these estimates would also be the same for the total discharge of springs, seeps, and groundwater withdrawals on and immediately off post (Chafin 1996).

Watts and Ortiz (1990) estimated discharge from the terrace alluvial aquifer along the southern edge of the landfill and areas south of the landfill to be 9600 to 19,200 ft^3/d, or 80 to 160 acre-ft/year. Groundwater along the southern boundary discharges in seeps and springs along the terrace edge, flows across the exposed Pierre Shale, and infiltrates into unconsolidated material adjacent to the terraces. Heavy plant growth in this area reduces water flow, and not enough water is discharged to reach the Arkansas River aquifer to the south

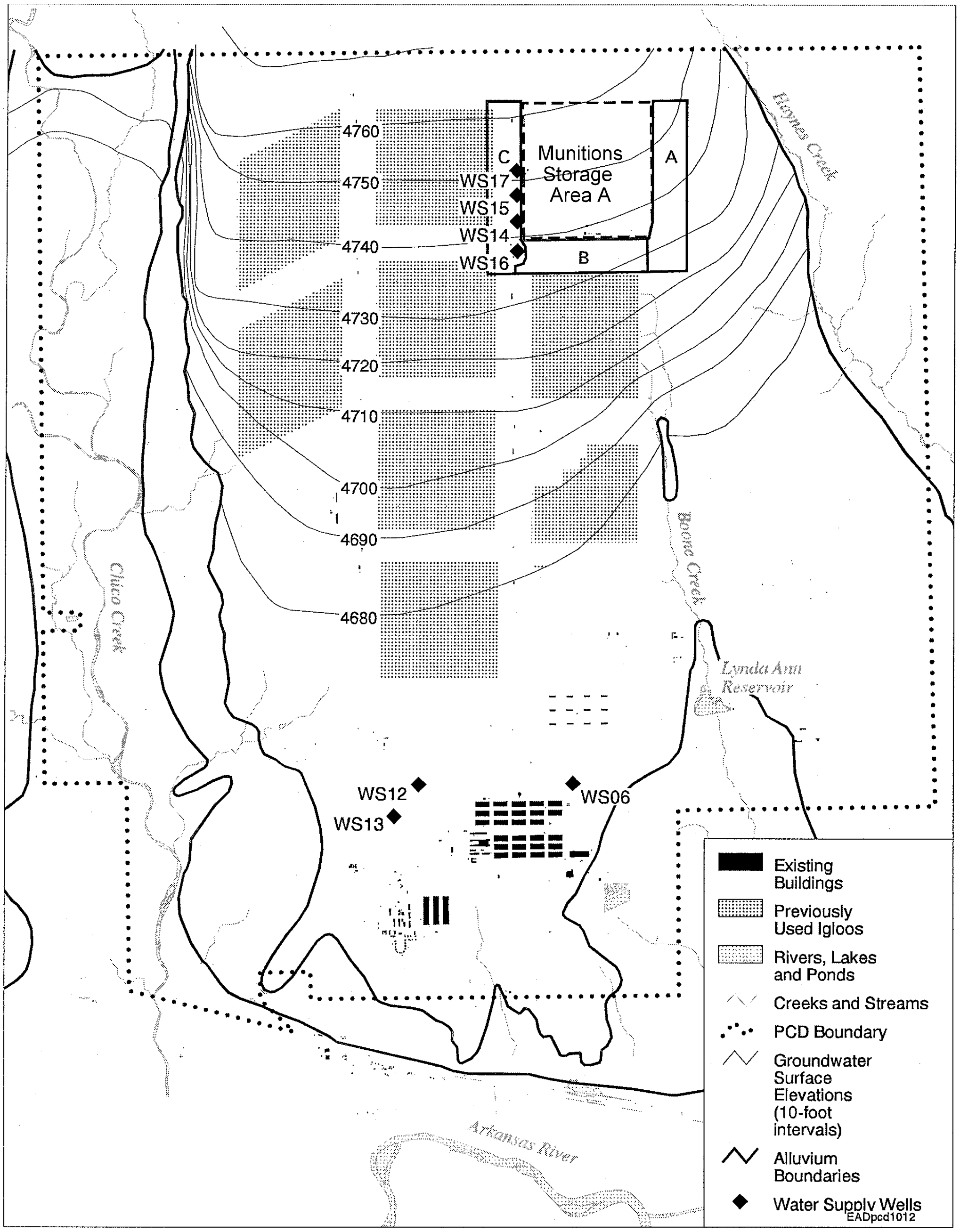


Fig. 4.11. Groundwater Surface Profile and Water Supply Wells at Pueblo Chemical Depot. *Source:* PCD Environmental Database.

(Watts and Ortiz 1990). However, there is a possibility that the Arkansas River aquifer may receive surface water flow from the terrace alluvial aquifer that originated as groundwater discharge (Ebasco Environmental 1990).

4.13.1.3 Groundwater quality

Groundwater in the terrace alluvial aquifer is sodium-bicarbonate type and generally of good quality (U.S. Army 1994) north of the administrative area. Specific conductance is generally less than 800 μS/cm, with the smallest values in the north (Chafin 1996). Values increase to the south and toward seepage faces. Chafin (1996) reported a high value of 3300 μS/cm near the landfill in the south and suggested that this was a result of contamination. Dissolved solids are generally at levels of less than 500 mg/L, except in water in the southern portion near the landfill (Chafin 1996) and in water in areas of known contamination.

In general, with the noted exception of the contaminated areas in the southern portion of PCD, groundwater below PCD meets the primary state and federal standards for drinking water, except for the selenium standard (U.S. Army 1984). Near the landfill, sulfate and nitrate levels exceed the secondary drinking water standards (Watts and Ortiz 1990). Selenium concentrations range from a low of 0.008 to a high of 0.02 mg/L (U.S. Army 1984). The federal standard for selenium in drinking water is 0.01 mg/L. The high selenium levels are derived from local geological materials that have naturally high selenium concentrations. Sulfate concentrations range from 222 to 720 mg/L near the landfill, and several wells have exhibited high nitrate concentrations. Nine of fifteen wells sampled by Watts and Ortiz had nitrate levels above 10 mg/L (Watts and Ortiz 1990). The secondary drinking water standard for sulfate is 250 mg/L (40 CFR 143.3), and the primary maximum concentration level (MCL) for nitrate is 10 mg/L (40 CFR Part 141).

Near the landfill in the southern section of PCD, dissolved solids range from about 700 to 1800 mg/L (Watts and Ortiz 1990) and increase downgradient across the landfill. Watts and Ortiz (1990) identified two organic contaminants in the groundwater downgradient of the landfill: trichloroethylene (TCE) and trans-1,2-dichloroethylene (DCE). TCE concentrations ranged from 5.2 to 2900 μg/L, and concentrations of DCE ranged from nondetectable levels (i.e., the detection limit is 5 μg/L) to 720 μg/L. Watts and Ortiz (1990) suggest that there is more than one source for the organic contamination: the landfill and another location to the north of the landfill. Rust, Inc. (1997) indicates that in addition to the Landfill, the Plating Waste Drainage Ditch and sumps in former Building 547, both to the north of the Landfill, are sources of groundwater contamination. The findings from the Rust report support the Colorado Department of Public Health and Environment (CDPHE) Compliance Order on Consent. The MCL for TCE is 5 μg/L and for DCE is 100 μg/L (40 CFR Part 141).

Rust, Inc. (1997) reports the presence of an organic contaminant groundwater plume south of the landfill which is being contained by the Interim Corrective Action Groundwater Remediation System (ICAGRS) along the southern PCD boundary. Explosive compounds have been identified in groundwater in the southwestern portion of PCD and at low concentrations at an offsite spring just north of Highway 96. While Rust, Inc. (1997) describes connection between the alluvial aquifer and the Arkansas River Valley aquifer near Chico Creek and Unnamed Creek in the south central portion of PCD, there is no evidence that groundwater reaches the Arkansas River Valley aquifer from the alluvial aquifer as groundwater. However, surface flows from springs and seeps may reach the Arkansas River Valley aquifer.

No organic contaminants were found in the Arkansas River Valley aquifer immediately south of the landfill; a plume of explosives products has been identified to the east. Some groundwater at Avondale has apparently been contaminated from this explosives products plume emanating from the TNT Washout Facility, a RCRA solid waste management unit. The groundwater is undergoing treatment both on-site and at the PCD boundary. As discussed in Section 4.13.4, none of the alternatives for destruction of chemical munitions would be expected to adversely affect these groundwater remediation activities.

To address groundwater contamination in the southern portion of PCD, the ICAGRS was constructed and placed into operation in March 1995 (Cain 1999 [GPW-5]). The goals of this system are to stop off-site migration of contaminated groundwater, treat captured groundwater to meet regulatory guidelines, reduce existing off-site contamination levels, and produce a continued decrease in contaminant levels (Cain 1999 [GPW-5]). The system is located near the south-central section of PCD and includes 54 recovery wells along the southern boundary of PCD. Groundwater is treated by using air-stripping for organic contaminants and, if needed, carbon filters for inorganic contaminants. The majority of the treated water is infiltrated downgradient of the recovery well system through infiltration galleries. The remainder is released by surface discharge to Unnamed Creek (Cain 1999 [GPW-5]).

4.13.1.4 Historical and current water use

PCD currently has 11 water supply wells and water rights to 1000 acre-ft/yr from seven of these wells (U.S. Army 1984) completed in the terrace alluvium north of the eastern part of the warehouse area (Ebasco Environmental 1990). Only four of these wells are currently in use. These wells vary in the amount of selenium present. The mixed water has fairly consistent selenium concentrations between 0.011 and 0.012 mg/L. Figure 4.11 shows the location of these wells.

When PCD was established in 1942, six water supply wells were initially drilled north of the warehouse area (U.S. Army 1984). In 1961, one more well was added in the standard magazine area. In 1971, two wells were added near the salvage yard, and in 1975, four wells were added in the igloo area. Four of the original six wells were retired when the last four wells were added (U.S. Army 1984). All wells were equipped with 0.5 m^3/min (150-gal/min) pumps powered by 5-hp electric motors (U.S. Army 1984).

In 1943, peak withdrawal was 4 million gal/month; this increased to 13 million gal/month in 1966 (U.S. Army 1984). Withdrawal decreased slightly, and, in 1981, the average withdrawal was 7.8 million gal/month, and the peak withdrawal was 10 million gal/month in July (U.S. Army 1984). In 1981, total water withdrawal was 94 million gal (290 acre-ft) (U.S. Army 1984). PCD has rights to extract about 330 million gal/year (1,000 acre-ft/year) from the terrace alluvium aquifer. Current water use is approximately 1.4 million gal/year (4.3 acre-ft/year) from four water supply wells.

These large groundwater withdrawals dewatered the terrace alluvial aquifer significantly over time. Between 1943 and 1970, there was 27 ft of drawdown near the center of the aquifer. In this region, the aquifer had a saturated thickness of about 35 ft (U.S. Army 1984), and this drawdown was enough to influence the capacity of the wells. The new wells added in 1971 were located about 1 mile to the west of the original field. After these wells were added, the declining trend noted in the water table stabilized or reversed slightly (U.S. Army 1984).

In addition to a declining water table, a general decline in water quality also occurred. Water samples from the original well field show an increase in total hardness from 70 mg/L in 1952 to 135 mg/L in 1967. In 1981, the measured value was 130 mg/L (U.S. Army 1984). Dissolved solids also increased from about 250 mg/L in 1952, to 370 mg/L in 1967, and 389 mg/L in 1981).

There are also a number of private wells off post between the southern boundary of PCD and the Arkansas River.

4.13.1.5 Current and historic water treatment

Wastewater is treated on post in the East Lagoon System, which consists of two lagoons with a total area of 15 acres (U.S. Army 1984). The lagoons are lined with 30 miles of polyvinyl chloride (PVC) to prevent leakage (U.S. Army 1984). The lagoon discharges are regulated under a National Pollutant Discharge Elimination System (NPDES) permit that allows discharge to Boone Creek at a rate of 167,000 gal/d (U.S. Army 1984); but no discharge has occurred. Historically, small septic tank/drain field systems were present on post. A second system, Munitions Storage Area A Lagoon System, which consists of two lined lagoons with a total volume of 6 million gal is located southeast of Munitions Storage Area A. See Sect. 4.6.1 for additional information about the Munitions Storage Area A Lagoon system. A third system, the West Lagoon System, was once in operation but has been closed.

4.13.2 Impacting Factors

Environmental impacts could occur to the groundwater resource during construction and operation of the alternative facilities. Impacts could result from depletion of the groundwater resource and alterations to the quality of that resource from construction.

4.13.3 Impacts of Construction

Impacts of construction of either the incineration or neutralization alternative facilities would be essentially the same. Direct environmental impacts could occur through depletion of the groundwater resource and its quality from groundwater use during construction. Indirect groundwater impacts include a reduction in availability to other users, and/or increased cost to those users. Because water used at PCD is diverted from other users, increased use could conceivably affect water use prices for other users. However, this impact is expected to be negligible because of the small volumes involved. Thus, these impacts will not be discussed further.

The assessment for the depletion of the groundwater resource compares the amount of that resource both currently used at PCD and the amount allocated by the state of Colorado with that required for the proposed facility and infrastructure construction. Estimated construction-related water needs are also considered from the groundwater resource depletion/renewal perspective. The assessment for alterations to groundwater quality compares the quality of the resource under current conditions with those estimated to occur during construction of the proposed facility.

Water for potable, sanitary, and process uses at PCD is derived exclusively from groundwater. As described earlier, current water use is approximately 4.3 acre-ft/year. Given similar expected groundwater withdrawal rates of between approximately 7 and 9 acre-ft/year (2,300,000 and 3,000,000 gal/yr) to support construction-related activities, impacts on water resources are expected to be similar for each of the technologies under consideration, but slightly lower for the two incineration alternatives. However, construction of the modified incineration alternative would require an estimated 23 months compared to the 32-34 months needed for the other alternatives. Thus total water requirements for construction of the modified incineration alternative would possibly be about 30 % less than for the other three alternatives.

Groundwater resource depletion can also be considered from the depletion/renewal perspective. As described above, the alluvial aquifer is estimated to receive from 400 to 900 acre-ft/year of recharge (groundwater resource renewal). Assuming the most conservative groundwater resource recharge estimate, the estimated 7 acre-ft/year of construction-related groundwater use for the two incineration alternatives is about 1.8% of the annual renewal of the groundwater resource and 0.6% of the less conservative recharge estimate. The values would be slightly higher for construction of the two neutralization alternatives. These values are considered to represent negligible to small impacts.

As described above, groundwater quality is considered to be generally good with the exception of naturally occurring elevated selenium levels throughout the aquifer and contamination-related sulfate and nitrate levels in the southern portion of PCD. Compared with annual aquifer recharge, the incremental increase in water usage during construction would not be expected to result in significant increases in these contaminant levels.

4.13.4 Impacts of Operations

4.13.4.1 Impacts of baseline incineration

Direct environmental impacts could occur through depletion of the groundwater resource and its quality from groundwater use during operation. Estimates of annual and operational lifetime water requirements for each alternative are shown in Table 4.27. Groundwater impacts from accidents are described in Sect. 4.22.7. Indirect groundwater impacts include a reduction in availability to other users, and/or increased cost to those users.

Direct operational impacts to groundwater are assessed in the same manner as those during construction. Estimated potable water use is about 20 acre-feet/year (Kimmel et al. 2001) while process use is estimated to be 30 acre-ft/year for a combined 50 acre-feet/year. This compares with the current usage of about 4.3 acre ft/year, and represents about 5% of PCD's annual allocation. From a resource depletion/renewal perspective, this accounts for between 4.2% and 13% of the annual renewal of the groundwater resource. It has been estimated that a total of 267 acre-feet of groundwater would be withdrawn over the 65-month operational lifetime of the baseline incineration alternative. A temporary, localized decline in the water table would accompany this amount of groundwater withdrawal. However, it would be quite reasonable to expect recovery of both water quantity and quality in two years or less, for any of the alternative technologies, because of the following factors: (1) a groundwater inflow rate from the north of the PCD site of between 400 and 1200 acre-ft/year, (2) an unknown quantity of infiltration from on-site precipitation and streams, and (3) cessation of

Table 4.27. Annual (ac-ft/y) and lifetime (ac-ft) operational water withdrawals for each alternative. Values in parentheses are in million gallons per year and million gallons, respectively.

Alternative	Baseline[a]	Mod. Baseline[b]	Neut/SCWO[c]	Neut/Bio[d]
Process Water, acre-ft/y, (million gal/yr)	29.9 (9.7)	24.2 (7.9)	4.0 (1.3)	17.5 (5.7)
Lifetime Process Water, acre-ft (million gal)	162 (52.7)	60.5 (19.7)	9.2 (3.0)	53.4 (17.4)
Potable Water, acre-ft/y (million gal/yr)	19.6 (6.4)	19.6 (6.4)	19.6 (6.4)	19.6 (6.4)
Lifetime Potable Water, acre-ft (million-gal)	106 (34.7)	49.1 (16)	45.4 (14.8)	59.8 (19.5)
Annual Total acre-ft/y (million gal/yr)	49.5 (16.1)	43.9 (14.3)	23.6 (7.7)	37.1 (12.1)
Lifetime Total acre-ft (million-gal)	267 (87.4)	110 (35.7)	54.6 (17.8)	113 (36.9)

[a]Operational lifetime of 65 months.
[b]Operational lifetime of 30 months.
[c]Operational lifetime of 28 months.
[d]Operational lifetime of 36 months.

groundwater withdrawals of up to 50 acre-ft/year for chemical destruction operations. Recovery, could be affected if other users increase withdrawals, or a severe drought should occur. Any competing groundwater users that happen to be very near the chemical agent destruction facility would possibly be affected by the temporary, local drawdown of the water table. Other onsite users further away, the groundwater remediation operations several miles south of the proposed site for the facility, and off-site groundwater users would not likely be affected.

Direct impacts to groundwater quality are assessed in the same manner as those during construction. Compared with both current water use and annual aquifer recharge, the incremental increase in water usage could result in local increases in selenium and hardness. While selenium and hardness levels might increase, they cannot be accurately predicted. However, such potential deterioration in groundwater quality would likely be short-lived because of the relatively high aquifer recharge rate, and would therefore likely return to pre-operation conditions soon after operations are concluded.

None of the alternatives for destruction of chemical munitions would be expected to adversely affect on-going groundwater remediation activities.

Wells in the terrace alluvial aquifer beneath PCD cannot pump amounts great enough to impact areas long distances from the well because the aquifer is thin, generally less than 30 - 40 feet in thickness, and the wells therefore would go dry. The region of the aquifer immediately down-gradient (south) of the production wells could be affected; however, this portion of the aquifer terminates on the bluffs south of PCD in a series of seeps and springs. There would be no regional lowering of the water table due to groundwater use for any of the alternative technologies for destruction of chemical munitions. The region of the terrace alluvial aquifer affected by proposed groundwater withdrawals lies completely within the existing PCD boundary.

The terrace alluvial aquifer does not directly connect with either the Chico or Boone Creek aquifers (The ICARGS and other remediation wells are all in the Chico Creek aquifer). As noted previously, the terrace alluvial aquifer ends on the bluffs surrounding PCD in a series of seeps and springs. Some water from these seeps and springs moves through the slopes to the lower more productive aquifers, but the amount is small. Given (1) the time period of construction and operation, (2) the amount of water withdrawn, and (3) the distance of the remediation facilities from the production wells (about 7 mi), it is unlikely that changes in the groundwater flow at the southern end of PCD (the outcropping of the aquifer) would be noticed. Finally, water use by a chemical munitions destruction facility would be significantly below historical PCD peak uses which occurred in 1983, and which showed no measured impacts to the Chico or Boone Creek aquifers.

Under certain conditions, additional water may have to be purchased from other water rights holders. This would be done on a free market basis, thus the water could come from any current water use in the water use area. This is also true of drought conditions; water would need to be purchased from holders of senior water rights. The only water users that would be affected by groundwater withdrawals would be those who voluntarily sell or lease their water rights to the project. During any period in which such water is used by the project, that water clearly would not be available for other uses such as crop irrigation.

4.13.4.2 Impacts of modified incineration

Operational impacts on groundwater differ from those with baseline incineration. Potable groundwater use is about 20 acre-ft/year, the same as for baseline incineration, but process water use is estimated to be only 24 acre-ft/year for a total estimated annual water requirement of 44 acre-ft/year, or 88% of the total of 50 acre-ft/year required by the baseline alternative (Table 4.27). It should be noted that not only does modified incineration have a lower annual water requirement (44 acre-ft/year, or as much as 12% less water per year), but that operations are expected to be completed in only 30 months, compared to about 65 months for the other alternative technologies. Thus, based on available predictions of water use, modified incineration would require a total of about 110 acre-ft, while baseline incineration, neutralization with biotreatment, and neutralization with SCWO would require approximately 270, 113, and 55 acre-ft respectively. Modified incineration would therefore, have a modestly lower impact on groundwater level than would the baseline incineration alternative. Total withdrawals, however, would be less than half of the withdrawals under the baseline alternatives.

4.13.4.3 Impacts of neutralization alternatives

The neutralization with SCWO alternative would require approximately 4.0 ac-ft/year of process water in addition to the 20 ac-ft/year needed for potable uses. Neutralization with biotreatment, on the other hand, would require approximately 17.5 ac-ft/year of process water in addition to the 20 ac-ft/year of potable water (Table 4.27). Thus total water requirements for the neutralization with SCWO alternative (24 ac-ft/year) would amount to between 2.0% and 6.0% of the estimated groundwater inflow of 400 - 1200 ac-ft/year. This compares with the 3.1% to 9.3% of estimated groundwater recharge that would be required for the neutralization with biotreatment alternative, 4.2% to 13% for the baseline incineration alternative, and 3.7%

to 11% for the modified incineration alternative. Thus the impact of local groundwater depletion from all four alternative disposal systems would be considered low-to-moderate, that is, low for the neutralization with SCWO alternative and moderate for the baseline incineration alternative as a result of more than twice the withdrawal rate. Modified baseline incineration and neutralization with biotreatment would have intermediate levels of impact on the groundwater resources. As shown in Table 4.27, the differences in total groundwater withdrawals over the operational life of each of the alternatives are considerable. For example, baseline incineration would use nearly two and half times as much water as the modified baseline and neutralization with biotreatment alternatives, and nearly five times as much as the neutralization/SCWO alternative.

4.13.5 Impacts of No Action

The groundwater resource would not be adversely impacted by continued storage of chemical agent at PCD. Procedures are in place to clean up chemical spills that could impact groundwater.

4.13.6 Cumulative Impacts

Depending on the quantity required by future users, the cumulative impact of groundwater withdrawals for any one of the alternative disposal systems in concert with existing groundwater usage and other potential future actions, would range from 2% to 14% or more of the total groundwater inflow to the aquifer underlying the PCD property. Of the four alternatives, baseline incineration would contribute most to these cumulative effects; neutralization with SCWO would contribute least. However, these impacts would be temporary (i.e., unlikely to extend much beyond the period of operations), and conditions prevailing prior to commencement of operations would be expected to return soon after operations cease (see Section 4.13.4.1).

4.14 SURFACE WATER

4.14.1 Existing Conditions

PCD is located in the Arkansas River drainage basin, on an alluvial terrace deposit, north of the river and approximately 150 ft in elevation above it. The alluvial terrace is underlain by the relatively impermeable Pierre Shale (see Sect. 4.13). Surface runoff is low because of the low precipitation at 11 in. per year and potentially high rate of evaporation at 48 in per year (Chafin 1996). The surface of the alluvial terrace slopes at a grade of approximately 1% (U.S. Army 1984) southward toward the Arkansas River; surface runoff is also generally to the south.

The Arkansas River is a major source of potable, industrial, and agricultural water in the area. In the basin, numerous canals divert water from the river for irrigation and other uses. These diversions significantly affect flow in the river. Pueblo Reservoir, located approximately 5 miles upstream from the City of Pueblo, is used for water storage and flood regulation on the Arkansas River. The Arkansas River east of the City of Pueblo has a large number of diversion structures and water withdrawals. A U.S. Geological Survey (USGS) gauge is located at Avondale, Colorado, almost directly south of PCD. Over the 11-year period from 1988 to 1999, daily mean flows at this gauge ranged from a minimum of about 210 to 7,000 ft^3/s. The mean daily flow over this period was approximately 980 ft^3/s, and the median flow was 640 ft^3/s (USGS 2000b). High flows generally occurred in the early summer months, and low flows occurred in the winter. Downstream from PCD, the mean flow decreased over the same 10-year period. Another gauge is located approximately 5 miles downstream of PCD at Catlin Dam, which is used to divert Arkansas River water into the Catlin Canal. At the Catlin gauge from 1988 to 1998, the average daily mean flow was 780 ft^3/s; the median daily mean flow was 500 ft^3/s; and minimum and maximum daily mean flows were 45 and 6,560 ft^3/s, respectively. Approximately 50 miles downstream at the USGS gauge at Las Animas, the average daily mean flow from 1988 to 1998 was about 310 ft^3/s; the median daily mean flow was only 3.7 m^3/s (130 ft^3/s); and minimum and maximum daily mean flows were 17 and 5,960 ft^3/s, respectively. The City of Avondale public water supply intake is located directly south of PCD. From PCD, the next nearest downstream municipal water supply on the Arkansas River is Rocky Ford, which is approximately 20 miles east of PCD.

Figure 4.12 shows the three surface drainages on the PCD site: Chico Creek near the western border of PCD controls drainage in the western portion of PCD; Boone Creek, which begins on post near the Munitions Storage Area A igloos, controls drainage from the central portion of PCD; and Haynes Creek, which crosses the northeast corner of PCD and continues along the eastern border of the post, controls drainage from the eastern portion of PCD. Flow in Haynes Creek is determined in part by the release of water from a reservoir drainage immediately North of PCD. Chico Creek is generally considered intermittent in North PCD (personal communication, M. Canestorp, USFWS, to G. Eddlemon, Nov. 20, 2001). Boone Creek is a spring-fed perennial stream near its head. It was once fed with sewage treatment plant effluent in its southern portion (Ebasco Environmental 1990); however, the sewage treatment plant is no longer in use. There is also a small creek (called Unnamed Creek in this document) that begins on-post near the landfill and exits the post near the ICAGRS on the south-central boundary. Water from Boone, Chico, and Haynes Creeks eventually enters the Arkansas River south of PCD, although Unnamed Creek has no channel south of Highway 96 (Ebasco Environmental 1990).

Springs and seeps occur along the edges of the upland terrace where the groundwater aquifer discharges to the surface at the bedrock-alluvium contact (Ebasco Environmental 1990). Channels for the creeks are incised through the alluvium into the bedrock. Groundwater surface level measurements indicate that groundwater discharges to Boone and Haynes Creeks (Chafin 1996) as well as to the south, along the face of the terrace above the Arkansas River.

One reservoir and one small pond exist on post (Fig. 4.12). Two other small ponds exist: one near Haynes Creek outside the eastern boundary of PCD and one near Chico Creek just outside the western boundary of PCD. Lynda Ann Reservoir is created by a small dam approximately 20 ft high on Boones Creek. It is used primarily for runoff control. The reservoir is approximately 18 acres in size and is fed by Boone Creek and small seeps and springs that occur at the alluvium-bedrock contacts in the incised streambed near the reservoir.

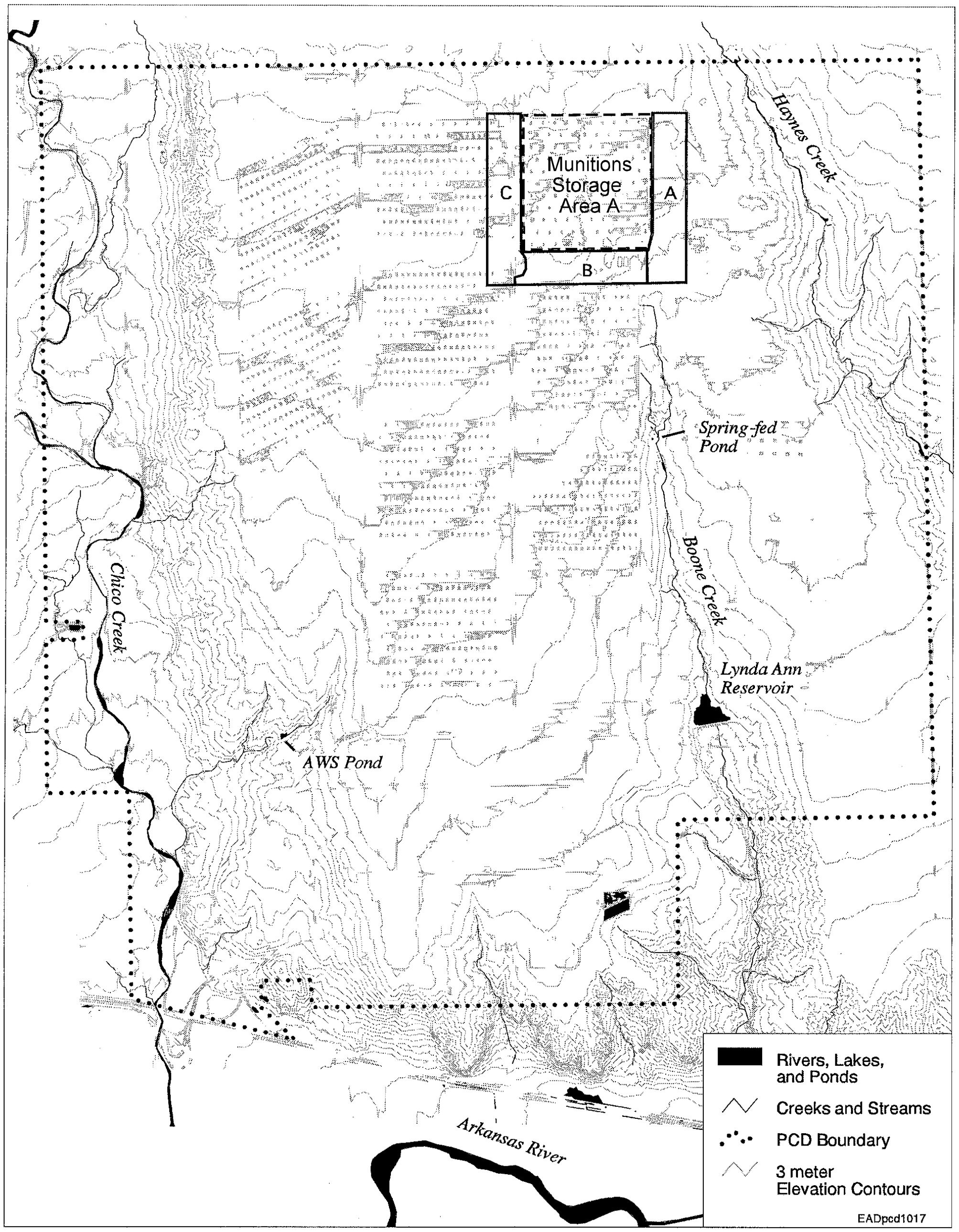


Fig. 4.12. Surface Water Features at Pueblo Chemical Depot. *Source:* PCD Environmental Database.

4.14.1.1 Floodplains

PCD is located on a raised terrace (Sect. 4.3) that is about 150 ft above the Arkansas River. The proposed facility site is located on high ground north of Boone Creek and west of Haynes Creeks and is outside the 100-yr floodplain.

4.14.1.2 Water quality and treatment

Although surface waters on PCD are limited, their quality is generally good. Lynda Ann Reservoir is relatively turbid, but fish are present (U.S. Army 1984). The Spring-Fed Pond, which is located north of Lynda Ann Reservoir at the headwaters of Boone Creek is shallow and contains small aquatic organisms.

Storm-water control at PCD is addressed by buried storm sewer piping in the administration areas and open ditches in the igloo storage areas (U.S. Army 1984). The collected storm-water runoff from the administration area is discharged to Boone and Chico Creeks. Near the landfill, runoff is discharged to Unnamed Creek. Drainage ditches are used to control storm-water runoff in the igloo storage area and discharge into Chico and Boone Creeks only after substantial precipitation (Ebasco Environmental 1990).

The USGS operated a gauge on Chico Creek from May 2, 1997, to September 30, 1998. During this period, the average flow was slightly more than 3 ft^3/s, and the maximum flow, which occurred on July 30, 1997, was slightly more than 330 ft^3/s. During this period, only one day had flows of more than 300 ft^3/s, and only four days had flows of more than 100 ft^3/s. The flow as measured in Chico Creek during this period was less than average on 476 of the 598 days on record, or approximately 80% of the time. For 187 days (31% of the time), flow was less than 0.1 ft^3/s (USGS 2000b). Measured storm-water flow data for the other creeks are not available.

4.14.2 Releases to Surface Water

During routine, incident-free operation, no liquid effluents, hazardous or otherwise, would be released from either the destruction facility or support facilities into the surrounding environment. Sanitary waste resulting from operation of the facility would be discharged to evaporation lagoons. There would be minimal impact to the surface water regime from destruction plant discharges during incident-free operation.

4.14.3 Impacts of Construction

Construction-related impacts would differ little among the four alternative disposal systems under consideration. Direct impacts to Boone and Haynes Creeks could occur from surface erosion during construction, thereby increasing the turbidity of surface water in those water bodies. Best management and/or engineering practices using silt fences and hay bales and avoiding those creeks would greatly reduce the potential for construction-related erosion to diminish water quality. Guidance on best management and engineering practices is widely available (e.g., CDPHE 1996; USACE 1998; EPA 1996a; EPA 1993a; EPA 1992d; EPA

1992e). Alterations to the courses of those surface creeks are not anticipated to occur during construction. On or off-post impacts to surface water bodies are thus considered to be small.

There would be no foreseeable on or off-post impacts to surface water from construction of an incineration or neutralization destruction facility because no releases are anticipated. Construction-related impacts to overland water flow would be none to negligible, and, if impacts were to occur, they would exist for only a short period of time. During incident-free construction activities, no contamination of surface water would be expected. Best management and/or engineering practices during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks.

4.14.4 Impacts of Operations

4.14.4.1 Impacts of incineration alternatives

Baseline and modified incineration would require 50 and 44 ac-ft/yr, respectively for operations. Either incineration alternative potentially would cause low to moderate impacts on the local groundwater resource through additional depletion, which, in turn would potentially result in low to moderate impacts on volume or flow in on-site ponds and streams. Off-site surface waters would be unlikely to experience measurable reductions in volume or flow.

Operations under either alternative would not be expected to adversely affect surface water quality on- or off-site. Sanitary wastes would be treated and then directed to evaporation lagoons south of Munitions Storage Area A.

4.14.4.2 Impacts of neutralization alternatives

The neutralization with biotreatment alternative potentially would cause small-to-moderate impacts on the local groundwater resource through additional depletion (approximately 37 ac-ft/year), which, in turn would potentially result in small to moderate impacts on volume or flow in on-site ponds and streams. The depletion effect would be moderately less than under the baseline incineration (50 ac-ft/year) and modified incineration alternatives (44 ac-ft/year) (Table 4.27). Off-site surface waters would be unlikely to experience measurable reductions in volume or flow.

Under the neutralization with SCWO alternative, however, the groundwater impact of operations would be significantly less (withdrawal of about 24 ac-ft/year) than under any of the other alternatives. Therefore, impacts on local PCD and, to a lesser extent, off-site surface water volume or flow would be substantially less than the adverse effects of any of the other alternatives. In any event, the adverse effects attributable to any of the disposal system alternatives would not last much beyond the periods of operations.

Operations under neither alternative would be likely to adversely affect surface water quality on- or off-site. Sanitary wastes would be treated and then directed to evaporation lagoons south of Munitions Storage Area A.

4.14.5 Impacts of No Action

Surface water resources would not be adversely impacted by continued storage of chemical agent at PCD. Controls are in place to minimize soil erosion to surface water and to contain and treat surface spills or releases.

4.14.6 Cumulative Impacts

Any of the chemical disposal system alternatives would potentially have cumulative impacts on both the local groundwater resource and, indirectly and to a lesser extent, the surface waters receiving discharge from the aquifer. For example, addition of the expected groundwater requirements under the baseline incineration alternative (50 ac-ft/year) to the existing groundwater usage of approximately 4.3 ac-ft/year results in a total withdrawal of between 5% and 14% of the estimated recharge for the aquifer underlying PCD. The modified incineration and neutralization with biotreatment alternatives would result in moderately lower levels of impacts. Although requiring the least amount of groundwater, the neutralization/SCWO alternative in concert with existing water consumption rates would nevertheless still consume between 2% and 7% of the total groundwater recharge. Were both incineration and neutralization facilities to be constructed and operated at the same time, then up to 22% of the estimated aquifer recharge rate would be consumed for process and potable water needs, although probably for a shorter time. This amount of withdrawal would represent a possibly substantial, but temporary, impact on the local groundwater resource, and to a somewhat lesser extent, on local surface waters as well.

4.15 TERRESTRIAL HABITATS AND WILDLIFE

4.15.1 Affected Environment

Ecological resources at PCD are typical of and consistent with its upland location on a raised terrace about 150 ft above the Arkansas River. Surface runoff is low due to the low rate of precipitation and high evapotranspiration. The proposed facility site is located on high ground above perennial and between intermittent streams (see Sect. 4.2), and is outside the 100-yr floodplain.

Ecological surveys were conducted at PCD in July and September 1995 (Rust and E-E Management 1996). The survey results identified plant and animal species occurring in six major vegetation types (communities) at PCD. Ecological information presented here is also based on observations made during site visits in December 1999 and February 2000 as part of the preparation of this EIS, consultation with the USFWS on protected species, and the Integrated Natural Resources Management Plan for PCD (Canestorp 2001).

The PCD encompasses 23,000 acres characterized as gently sloping prairie or shortgrass steppe (Rust and E-E Management 1996). A total of 188 plant species were identified in six major vegetative types. The major types of vegetation on PCD include shortgrass prairie (it is the most common on the basis of total acreage), northern sandhill prairie, greasewood scrub, wetlands, riparian woodland, and disturbed/landscaped areas. Data on their distribution over the entire PCD are included in Rust and E-E Management (1996). A map of vegetation, including areas of transitional vegetation in the northern portion of PCD adjacent to Munitions Storage Area A, is included as Fig. 4.13. The areas include northern sandhill prairie, greasewood scrub, and northern sandhill prairie/shortgrass prairie/rabbitbrush transition vegetative types.

4.15.1.1 Vegetation at alternative chemical agent destruction facility locations

Different vegetation types are found at the alternative locations (Areas A, B, and C) for the facility. Area A is in a transitional area having floral components of both shortgrass prairie and northern sandhill prairie. Areas B and C are in shortgrass prairie and greasewood scrub. There are no survey data on vegetation in these three areas; however, the areas are representative of ungrazed areas in northern portions of PCD that were surveyed in 1995 (Rust and E-E Management 1996). Areas B and C have been heavily disturbed by post activities.

Area A, is located along the east boundary of Munitions Storage Area A. It lies in a grazed but otherwise undisturbed area transitional between northern sandhill prairie and shortgrass prairie. It is characterized by the occurrence of sand sagebrush (*Oligosporus filifolius*), sand bluestem (*Andropogon hallii)*, sandreed (*Calamovilfa longifolia)*, blue grama (*Chondrosum gracile)*, and cholla cactus (*Cylindropuntia imbricata*). The dominant grasses of ungrazed northern sandhill plant communities at PCD are blue grama, needle-and-thread (*Stipa comata)*, and purple three-awn (*Aristida purpurea).* Where mechanical disturbance or overgrazing occurred on northern sandhill prairie, forb and shrub species increased in both cover and composition (Rust and E-E Management 1996). Examples of species that are more common in northern sandhill prairie communities at PCD where disturbance has occurred include little rabbitbrush (*Chrysothamnus viscidiflorus)*, broom snakeweed (*Gutierrezia sarothrae)*, and plains prickly pear cactus (*Opuntia polyacantha)*.

Area B, which is along the south boundary of Munitions Storage Area A, is characterized by shortgrass prairie and greasewood scrub vegetative types. This area is ungrazed and includes several grass species that are low in height (i.e., generally less than 2 ft). The dominant grasses in terms of percent cover and composition are blue grama and purple three-awn. Other grasses occurring on shortgrass prairie sites surveyed included squirreltail (*Elymus elymoides)*, needle-and-thread, and sand dropseed (*Sporobolus cryptandrus)*. Forbs and shrubs collectively made up less than 20% of the total plant cover on shortgrass prairie sites surveyed during 1995 (Rust and E-E Management 1996). The greasewood scrub vegetative type on PCD is characterized by the presence of the shrubs black greasewood (*Sarcobatus vermiculatus)*, and three rabbitbrush species (*Chrysothamnus viscidiflorus, C. nauseosus*, and *C. pulchellus)*. The plant community in this vegetative type is more diverse than it is in northern sandhill prairie or shortgrass prairie. Surveys in 1995 showed that grasses made up about 65–70% of the total plant cover of ungrazed greasewood scrub areas, although shrubs visually appeared to be more dominant than grasses. The dominant grass species recorded were galletagrass (*Hilaria jamesii)*, blue grama, and alkali sacaton (*Sporobolus airoides)*.

Area C is located in shortgrass prairie vegetation within C-Block and immediately southwest of the current entrance to Munitions Storage Area A. The composition of plant species reflects the effects of revegetation after mechanical disturbance but is expected to be similar to that of other shortgrass prairie plant communities in the northern one-third of PCD. Some sand sagebrush has invaded the eastern portion of Area C. The southern third of Area C is entirely shortgrass prairie.

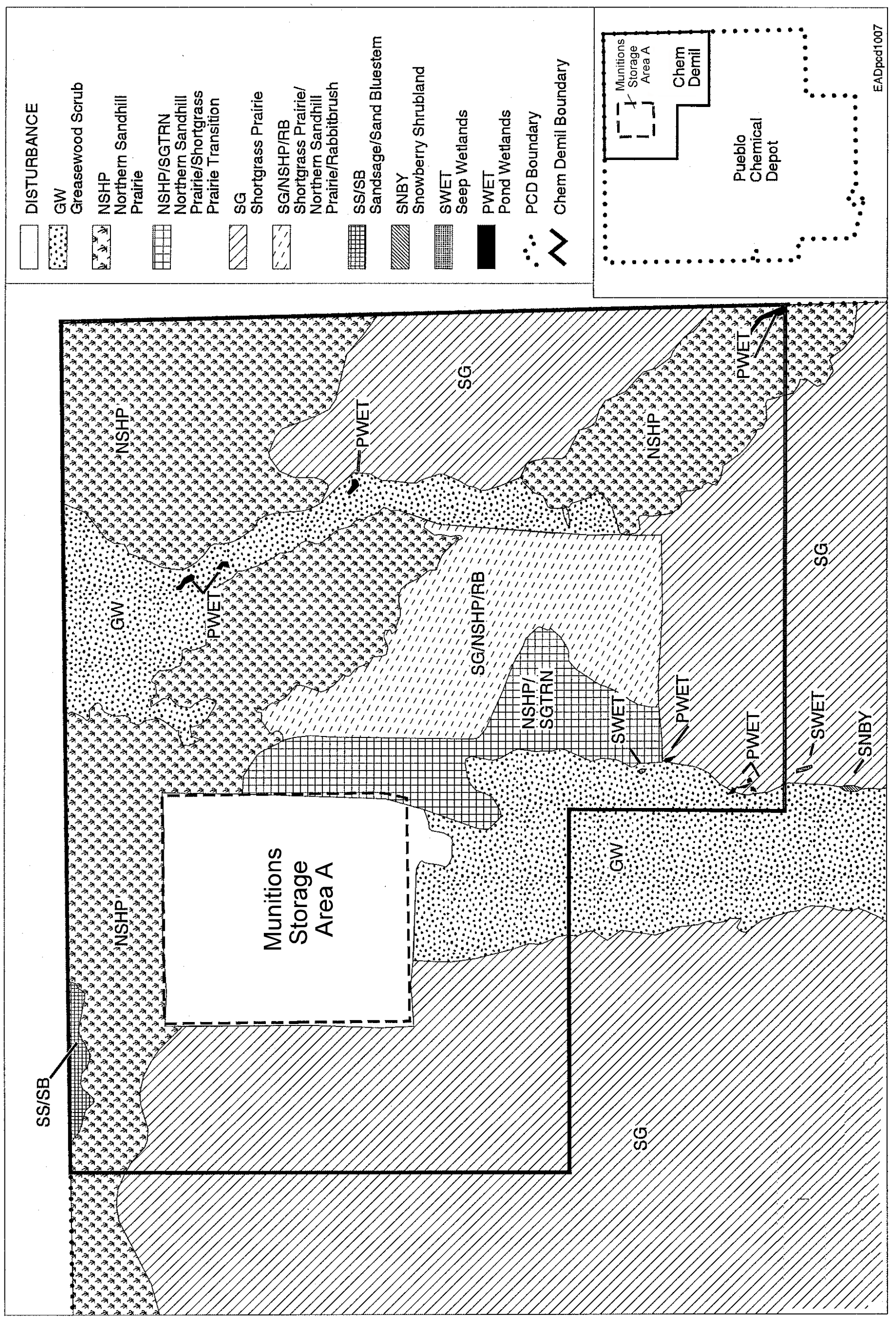


Fig. 4.13. Vegetation at Pueblo Chemical Depot. *Source:* PCD Environmental Database.

4.15.1.2 Wildlife

Quantitative surveys were conducted at PCD in 1995 for big game, small mammals, and birds. Survey techniques included live trapping, mark and release of small mammals, direct counts of birds along transects made by using the method to estimate density developed by Emlen (1971), and direct counts of big game herds. The following discussion presents data on common wildlife occurring throughout the site and on species that are known to be highly dependent on shortgrass prairie, northern sandhill prairie, and greasewood scrub plant communities.

Amphibians and Reptiles. Four amphibian species were observed at PCD. The great plains toad (*Bufo cognatus)* and western Woodhouse toad (*Bufo woodhousii)* are the most widely distributed species, occurring in all vegetative types. The bullfrog (*Rana catesbeiana)* was abundant at Lynda Ann Reservoir, located about 3 to 3.5 miles southeast of Munitions Storage Area A. The northern leopard frog (*Rana pipiens)* was observed in pools along Chico Creek and in effluent from the PCD water treatment plant south of the PCD boundary. Breeding habitat for amphibians exists in Lynda Ann Reservoir, in the Spring Fed Pond about 2.0 miles upstream of Lynda Ann Reservoir, along Chico Creek near the western boundary of PCD, and in the Ammunition Workshop Pond located about 4.0 miles southwest of Munitions Storage Area A. The tiger salamander (*Ambystoma tigrinum*) and plains leopard frog (*Rana blairi*) have been observed along Boone Creek drainage since the 1995 surveys were conducted (personal communication, K. M. Canestorp, USFWS, to E.D. Pentecost, ANL, May 1, 2000).

Ten reptilian species were observed at PCD. Species included one turtle, five snakes, and four lizards. Lizards are the most abundant reptile group. The checkered whiptail (*Cnemidophorus tesselatus),* six-lined racerunner (*C. sexlineatus),* and lesser earless lizard (*Holbrookia maculata)* were observed in all vegetative types except riparian woodland (Rust and E-E Management 1996). The red-lipped plateau lizard (*Sceloporus undulatus)* was observed in all vegetative types. The ornate box turtle (*Terrapene o. ornata)* was documented from northern sandhill prairie at PCD. Hammerson (1999) reports that the ornate box turtle inhabits grasslands and sandhill habitats in Colorado. The prairie rattlesnake (*Crotalus v. viridus)* was observed in all vegetative types, as was the bull snake (*Pituophis catenifer).* The central coachwhip (*Masticophis flagellum testaceus)* and eastern yellow-bellied whipsnake (*Coluber constrictor flaviventris)* were observed in the northern sandhill prairie and shortgrass prairie communities. The wandering garter snake (*Thamnophis elegans vagrans*) was observed in riparian woodland and disturbed habitat.

Birds. Quantitative surveys of birds were conducted in August 1995 along five 0.5-mi long transects in shortgrass prairie, northern sandhill prairie, riparian woodlands, and wetland habitats at PCD (Rust and E-E Management 1996). On the basis of the transect data, grassland-shrubland habitats supported a total estimated density of 977 (number of birds/ 50 acres).

Although no surveys were conducted at Areas A, B, and C, data collected in grassland- and shrub-dominated communities elsewhere on PCD are likely to be representative of the plant communities in the vicinity of Munitions Storage Area A. The most commonly observed bird species in the three major plant community types in the northern portion of PCD were as follows:

- Shortgrass prairie

- Lark sparrow	*Chondestes grammacus*
- Lark bunting	*Calamospiza melanocorys*
- Horned lark	*Eremophila alpestris*
- Mourning dove	*Zenaidura macroura*
- Western meadowlark	*Sturnella neglecta*

- Northern sandhill prairie

- Sage thrasher	*Oreoscoptes montanus*
- Western meadowlark	*Sturnella neglecta*
- Lark bunting	*Calamospiza melanocorys*
- Vesper sparrow	*Prooecetes gramineus*
- Western kingbird	*Tyrannus verticalis*

- Greasewood scrub

- Lark sparrow	*Chondestes grammacus*
- Western meadowlark	*Sturnella neglecta*
- Western kingbird	*Tyrannus verticalis*

Species observed only in shortgrass prairie communities during the ecological surveys include the ferruginous hawk (*Buteo regalis*), mountain plover (*Charadrius montanus*), and burrowing owl (*Athene cunicularia*). The burrowing owl uses burrows of the black-tailed prairie dogs for nesting and cover (Robbins et al. 1966). The western meadowlark was frequently observed in shortgrass prairie in the igloo areas. The rock wren (*Salpinctes obsoletus*) nests in rocky areas of berms adjacent to the igloos and also in the munition storage areas.

Raptors observed at PCD include the American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*B. swainsoni*), ferruginous hawk, great-horned owl (*Bubo virginianus*), barn owl (*Tyto alba*), and burrowing owl. The kestrel, red-tailed hawk, and Swainson's hawk were observed throughout PCD during the course of the ecological surveys. These three species nest in plains cottonwood trees at several locations. Northern harriers, barn owls, and great-horned owls nest on PCD. With the exception of Swainson's hawk, these raptors are permanent residents at PCD.

The mourning dove and scaled quail (*Callipepla squamata*) are the only upland game birds at PCD. Scaled quail were observed in flocks of about 5, 10, and 20 individuals in areas dominated by greasewood scrub and rabbitbrush within the igloo areas, around Lynda Ann Reservoir, and along Chico Creek.

Several species of waterfowl and shorebirds use the AWS Pond and Lynda Ann Reservoir during the summer breeding season and migration periods. Nine waterfowl and shorebird species were recorded during surveys conducted in August and September 1995 and from incidental observations made in spring and fall (Rust and E-E Management 1996). The most common summer residents included the mallard (*Anas platyrhynchos),* blue-winged teal (*A. discors*), American coot (*Fulica americana*), and killdeer (*Charadrius vociferus*). The great blue heron (*Ardea herodias*) frequents the Lynda Ann Reservoir and ponds on PCD during the winter. Large flocks of Canada geese (*Branta canadensis*) have been observed during the fall migration on Lynda Ann Reservoir. Snow geese (*Chen caerulescens*) also use the reservoir during fall migration.

Mammals. Twenty six mammalian species were recorded at PCD during field surveys in 1995 (Rust and E-E Management 1996). As a group, rodents are the most abundant; 19 species were recorded during the surveys. Common rodent species of the shortgrass prairie included the black-tailed prairie dog (*Cynomys ludovicianus)*, thirteen-lined ground squirrel (*Spermophilus tridecemlineatus)*, and spotted ground squirrel (*S. spilosoma)*. Up to 10 prairie dog towns were inhabited in any one season within the shortgrass prairie. Black-tailed prairie dog populations have fluctuated drastically from year to year because of plague (personal communication, K. M. Canestorp, USFWS, to E.D. Pentecost, ANL, December 7, 1999). One active prairie dog town currently located immediately west of Area B, extending on each side of the north/south access road to the west entrance of Munitions Storage Area A was observed in February 2000.

Other common rodent species captured during the small mammal live-trapping surveys (Rust and E-E Management 1996) included Ord's kangaroo rat (*Dipodomys ordii)*, plains pocket mouse (*Perognathus flavescens)*, western harvest mouse (*Reithrodontomys megalotis),* northern grasshopper mouse (*Onychomys leucogaster)*, and deer mouse (*Peromyscus maniculatus)*. The western harvest mouse occurred in greatest numbers in all vegetative types having a dense grass cover. This species probably occurs in the dense, grass-covered areas within the munitions storage complex at PCD, but no trapping was conducted in these areas to confirm this conclusion. Northern grasshopper mice were captured frequently in both grazed and undisturbed habitats in all vegetative types except ungrazed greasewood scrub. The Ord's kangaroo rat was captured in shortgrass prairie, northern sandhill prairie, and greasewood scrub communities. Population density was estimated at 15 individuals per acre on the basis of 1995 live-trapping data (Rust and E-E Management 1996).

Both the black-tailed jackrabbit (*Lepus californicus)* and white-tailed jackrabbit (*L. townsendii)* were observed during the field surveys. Jackrabbits were most common in shrub-dominated areas of riparian woodland and greasewood scrub but were not abundant at PCD. The desert cottontail (*Sylvilagus audubonii)* was observed in all habitat types but was not abundant enough to allow density calculations.

No surveys for bats have been conducted at PCD. Individual bats were observed foraging in the vicinity of Lynda Ann Reservoir and along Chico Creek during the evening.

Five carnivores recorded during the surveys included the coyote (*Canis latrans)*, swift fox (*Vulpes velox)*, raccoon (*Procyon lotor)*, badger (*Taxidea taxus)*, and striped skunk (*Mephitis mephitis)*. The coyote is the most abundant carnivore; it occurred in all habitats and frequently was seen in the igloo areas of the munitions storage areas. The striped skunk probably occurs in all habitats at PCD, while the raccoon is likely to be more common in riparian woodland and wetland habitats.

The pronghorn (*Antilocapra americana)* is the most abundant big game mammal at PCD. Pronghorns are commonly observed in shortgrass prairie. Herds of up to 35 individuals occur in eastern and western portions of PCD. Mule deer (*Odocoileus hemionus)* and whitetail deer (*O. virginianus)* are most common in riparian woodland along Chico Creek. During the early evening, deer move to greasewood scrub and northern sandhill prairie when foraging (Rust and E-E Management 1996).

4.15.2 Impacting Factors

Impacting factors include construction activities, releases and spills, and accidents as discussed in the sections below.

4.15.3 Impacts of Construction

The following text presents the potential environmental consequences to terrestrial habitats and wildlife from siting and constructing an agent destruction facility under each of the four alternatives considered in this document: baseline incineration, modified incineration, neutralization with SCWO, and neutralization with biotreatment. The potential impacts from construction and operation are summarized in Table 4.28. Impacts from construction on biotic communities would be essentially the same regardless of the destruction technology used, given the similarity in space requirements, construction activities, and durations for construction of the facilities associated with each.

The following discussion of construction impacts identifies the potential impacts from building a facility within the three areas around Munitions Storage Area A identified as possible sites for the destruction—Areas A, B, and C (Fig. 4.1)—and those from developing the associated infrastructure (e.g., electrical power supply, gas and water pipelines, access roads). Mitigation measures that could minimize or prevent impacts on ecologically sensitive communities in these areas are listed in Sect. 4.26.

4.15.3.1 Vegetation

Ecological impacts resulting from site and infrastructure construction would be expected to be essentially the same for any of the four alternatives being considered. The actual amount of land that would be disturbed by construction might vary slightly with the system selected, but until engineering design studies are completed, the exact acreage that would be affected cannot be determined. Construction impacts would mainly result from clearing vegetation to prepare the site for the agent destruction facilities; installing a 115-kV transmission line, a new substation, and a sewage lagoon; and building pipelines for water and gas supplies.

Vegetation would be cleared on about 24 acres for construction of the facility, sewage lagoon, and new substation. The total area of vegetation that would be disturbed to accommodate site infrastructure would vary depending on which area (A, B, or C) was selected for the facilities. Table 4.29 shows the estimates of acreage that could be disturbed for site construction. A maximum area of approximately 85 acres could be disturbed during construction. In order to bound the analyses in this section, the estimates presented are based on conservative assumptions concerning road and utility construction to support the destruction facility. Even though the estimates are nearly double those presented elsewhere, the total area disturbed would still constitute much less than 1% of the total PCD area.

To provide electrical power to the PMCD or ACWA facility, a 115-kV transmission line would need to be extended to the facility location. The transmission line would probably be built on wooden H-frame towers along a 100-ft-wide right-of-way. Electrical power would be extended from an existing power line that runs parallel to the east boundary of PCD. The

Table 4.28. Effects of construction and operations on ecological resources

Impact Category	Construction	Operation
Terrestrial vegetation	Minimal; loss of 34 ha (85 acres)	None
Wildlife	Minimal; habitat loss; noise effects within 328 ft of site	Minimal
Protected species	Minimal; habitat loss for black-tailed prairie dog in Areas B and C; minor habitat loss for burrowing owl and mountain plover in Areas A, B, and C.	Possible reduction in habitat for state-listed endangered southern red-belly dace, and three aquatic and wetland species of concern
Wetlands	None	Possible low to moderate reductions in wetland habitat and resident populations
Aquatic ecosystems	None	Possible low to moderate reductions in aquatic habitat and resident populations
Sensitive plant communities	Potential impacts to northern sandhill prairie in Area A	None

transmission line would run either along Utility Corridor 2 directly to the construction site, or along Corridor 3 to the south end of Utility Corridor 1 and then north to the construction site. In either case an 35-ft-wide access road would be constructed. The length of new road would be about 0.5 miles for Utility Corridor 3, and up to about 2.5 miles for Utility Corridor 2. The actual impacts on vegetation would not occur within the entire right-of-way; the areas that would be affected would be the individual conductor stringing sites and tower construction sites (Table 4.29), which are relatively small when compared with the total area within the 100-ft-wide corridor. The total area within the right-of-way from the power line on the east along utility corridor 2 to Area A would be about 27 acres, to Area B would be about 27 acres, and the area to Area C would be about 45 acres.

To supply the proposed facilities with gas and water supplies, gas and water pipelines would need to be built. It was assumed that a 60-ft-wide corridor might be affected during installation of these pipelines, and that the pipelines would run along existing roadways. The total areas that could be affected by these pipelines are shown in Table 4.29. Areas disturbed along the 60-ft-wide corridor would be revegetated with a native grass and shrub seed mix recommended by the Natural Resources Conservation Service [personal communication, B. Forman, Natural Resources Conservation Service, to E. Pentecost, ANL, April 26, 2000).

Table 4.29. Estimated land area that could be disturbed to construct the Agent Destruction Facility and associated infrastructure

	Amount of Land Disturbed in acres		
Construction Activity	Area A	Area B	Area C
Facilities	20	20	20
Sewage evaporation lagoon	2	2	2
Electrical substation	2	2	2
Subtotal	24	24	24
Transmission lines (115-kV)[a]			
Towers	0.4-1.6	0.4-1.4	0.7-1.8
Conductor stringing	0.1-0.5	0.1-0.4	0.2-0.5
Construction access road[b]	36930	36931	36932
Gas pipeline[c]	37 - 43	37 - 43	37 - 43
Water pipeline[c]	5 - 6	4.5 - 5	4.5
Maximum possible area disturbed	85	85	85

[a]All transmission towers would be wooden H-frames; an area of 900 ft^2 would be disturbed at each tower site and conductor stringing/splicing site; tower spacing would be 600 ft; right-of-way width would be 100 ft (Bonneville Power Administration 1996); areas disturbed for towers and conductor stringing depend on whether Utility corridor 1 or 2 is selected.

[b]A new 35-ft-wide access road would be required extending from the east boundary to PCD either along Utility Corridor 2 directly to the construction site, or along Corridor 3 to the south end of Utility Corridor 1.

[c]The maximum width of corridor disturbed would be 60 ft.

Construction of the facilities in Area A would affect a vegetation transition area that consists of species typical of northern sandhill prairie and shortgrass prairie communities (Fig. 4.13). The northern sandhill prairie community, which occurs in the northern portion of Area A and immediately north of Munitions Storage Area A, is classified as a sensitive community type that is declining statewide by the Colorado Natural Heritage Program (CNHP 1999). By siting facilities in southern portions of Area A and limiting construction traffic and equipment in northern portions, impacts on northern sandhill prairie could be avoided.

Construction of the facilities in Area B would affect greasewood scrub vegetation. The central and eastern portions of Area B contain the most concentrated areas of shrubs, which consist mainly of sand sagebrush and greasewood.

Construction in Area C would affect low shrub and shortgrass communities west of the paved road that parallels the west boundary of Munitions Storage Area A. Constructing facilities near the center of Area C would avoid losses of the shortgrass prairie habitat that occurs in the southern portion of the area and supports a colony of black-tailed prairie dogs. The black-tailed prairie dog is a candidate species under consideration for listing as threatened by the U.S. Fish and Wildlife Service (*Federal Register*, Vol. 65, No. 24, February 4, 2000) under the Endangered Species Act. Also, siting facilities west of the entrance to Munitions Storage Area A would allow construction on vegetated areas previously disturbed by igloo construction.

4.15.3.2 Wildlife

Loss of habitat, increased human activity in the Munitions Storage Area A area, increased traffic on local roads, and noise would be the most important factors that would affect wildlife species. The presence of construction crews and increased traffic in the Munitions Storage Area A area would cause some wildlife species to avoid areas next to the construction site during the 32- to 36-month construction period. Wildlife inhabiting the area rely on native shrubs and grasses for food, cover, and nesting and therefore would be affected by vegetation clearing. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) would be killed during vegetation clearing and other site preparation activities. Amphibian and reptile species likely to be affected by loss of habitat would include the great plains toad, Woodhouse toad, ornate box turtle, checkered whiptail lizard, lesser earless lizard, and six-lined racerunner. Small mammals that would be affected by vegetation clearing include Ord’s kangaroo rat, plains pocket mouse, western harvest mouse, deer mouse, and northern grasshopper mouse. However, because there is an abundance of similar habitat next to cleared areas, no impacts on the continued survival of local populations of these species would be expected.

Construction in the southern portion of Area C could affect an existing black-tailed prairie dog colony located nearby, and desert cottontails which utilize black-tailed prairie dog towns. Increased construction traffic would increase the potential for road kills to species such as prairie dogs, desert cottontails, thirteen-lined ground squirrels, and spotted ground squirrels along the north-south road from the west entrance to Munitions Storage Area A. Scaled quail and mourning doves, important game birds in Colorado, would be adversely affected by loss of shortgrass prairie and shrub/grass transition habitat in Areas A and C. Kingery (1998) reported that scaled quail rely heavily on shortgrass prairie with cholla cactus and are more abundant in these areas than in shrub-dominated communities. Other birds that inhabit shortgrass prairie and northern sandhill prairie communities that would be affected by vegetation clearing include the burrowing owl (often associated with prairie dog colonies), lark sparrow, and western meadowlark.

Birds of prey at PCD would probably not be adversely affected by loss of a prey base associated with up to 85 acres of vegetation clearing, but they might avoid foraging in areas next to construction sites because of increased human activity. Species such as the ferruginous hawk, red-tailed hawk, and kestrel might benefit from the H-frame towers that would be constructed for the transmission line; they could use the towers as perch sites. Suitable raptor perches are generally absent on PCD, except for the trees and shrubs around Lynda Ann Reservoir, along Chico Creek, and in the housing area.

Raptor electrocution from simultaneous wing contact with two conductors or a conductor and ground wire on the 115-kV transmission line would not be expected. The largest raptors expected to visit PCD, the golden eagle and bald eagle, have a maximum wingspan of about 7.5 ft (Avian Power Line Interaction Committee 1996). A wooden H-frame tower for a 115-kV transmission line is typically designed with a 12.5-ft space between conductors; thus, an eagle could not contact both conductors simultaneously while in flight. The distance between a conductor and ground wire is normally longer than 9 ft. The use of electric distribution lines, which account for most raptor electrocutions, is not planned for supplying power to PMCD facilities. Instead, underground cables would extend from the substation to the various facilities requiring power. The design of the 115-kV transmission line would follow suggested practices for protecting raptors (Avian Power Line Interaction Committee 1996).

Noise levels generated by construction equipment would be expected to range from 85 to 90 dBA at the proposed PMCD or ACWA facilities (see Sect. 4.11.3). Levels would diminish to about 55 to 60 dBA at the northeast boundary of PCD. Results from numerous published studies indicate that small mammals might be adversely affected by maximum noise levels that could be produced by construction equipment (Manci et al. 1988; Luz and Smith 1976; Brattstrom and Bondello 1983). Manci et al. (1988), in an article reviewing the effects of noise on wildlife and domestic animals, reported that sudden sonic booms of 80 to 90 dB startled seabirds, causing them to temporarily abandon nest sites. The startle response of birds to abrupt noise and continuous noise and birds' ability to acclimate to noise seem to vary with species (Manci et al. 1988). Pronghorn antelope in New Mexico responded to helicopters at noise levels of 60 to 77 dB by running when a helicopter's altitude approached 150 ft and its horizontal distance from the antelope was about 500 ft (Luz and Smith 1976). In the laboratory, the hearing of the desert kangaroo rat (*Dipodomys deserti)* was affected when individuals were exposed to recorded dune buggy noise of 78 to 110 dB (Brattstrom and Bondello 1983). Three weeks were required for their thresholds to recover after exposure. Rodents within about 330 ft of the PMCD site during construction might experience some temporary hearing loss, which could reduce their ability to detect predators. Pronghorn antelope and mule deer would likely respond to noise and human activity by avoiding areas within 0.5 mile of ongoing construction.

4.15.4 Impacts of Operations

The following text presents the potential environmental consequences to terrestrial habitats and wildlife from operating an agent destruction facility under each of the four alternatives considered in this document: baseline incineration, modified incineration, neutralization with SCWO, and neutralization with biotreatment. The potential impacts from construction and operations are summarized in Table 4.28. Impacts of operating an agent destruction facility under any of the four alternatives considered would be essentially the same as discussed in further detail below.

Projections of air emissions were evaluated to determine ecological impacts that could result from normal (i.e., incident-free) operations of facilities associated with each of the four agent destruction systems. Air pollutant concentrations resulting from destruction operations are expected to be well below applicable standards for criteria pollutants and chemical agents (see Sect. 4.7 and 4.8). Trace elements would be dispersed over a large geographic area, resulting in deposition amounts that would be nondetectable or below levels known to be harmful to wildlife and vegetation. Therefore, no significant deposition of these pollutants should occur that would affect terrestrial habitats and wildlife in the vicinity of PCD.

Previous health risk assessments conducted as part of the RCRA permitting process for other U.S. Army chemical destruction facilities have also included screening level ecological risk assessments (SLERAs). These SLERAs have included screening level pathway analyses of the potential impacts from facility emissions upon ecological communities. That is, the previous SLERAs have attempted to determine if ambient concentrations of airborne and deposited constituents (as emitted from the proposed facilities) pose a threat to ecological communities, as opposed to specific individuals of any species. SLERAs will be conducted for the agent destruction facilities associated with each of the four alternatives considered in this document. It is anticipated that these analyses will demonstrate, as have the previous SLERAs conducted for other U.S. Army chemical demilitarization facilities, that ambient concentrations of airborne and deposited constituents (as emitted from the proposed facilities) pose little threat to ecological communities.

Operation of the facilities would result in increased human activity in the northeast quadrant of PCD. An increase in traffic along access roads caused by worker vehicles and the periodic delivery of supplies would increase the number of road kills of rodents and reptiles. Anticipated noise levels of 55 to 60 dBA near the facility boundary would have only minor impacts on birds and mammals. Any abrupt noise levels would startle birds and might cause them to temporarily abandon their nests. These levels would probably not interfere with the auditory function of birds and mammals.

During full operation, an estimated 5.1 million gal of sanitary effluent would be generated each year. It is anticipated that sanitary effluent would be discharged into a lined evaporative lagoon next to the test facilities. Some water would be present at all times in the lagoon, which could attract resident songbirds and shorebirds such as killdeer and spotted sandpiper. Waterfowl would not be likely to use the lagoon, since it would have only small areas of standing water and would not support wetland vegetation.

4.15.5 Impacts of No Action

No new construction would be associated with the no action alternative, therefore, there would be no impacts from construction to ecological resources.

Continued operations under the no action alternative, i.e., storage of chemical agents at PCD, would not adversely affect plant communities or wildlife populations in the vicinity of G-Block during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas. Periodic mowing of vegetation between the bunkers has prevented shrub species from establishing there. This type of vegetation control would probably continue in the future. No impacts on terrestrial habitats and wildlife would be expected as a result of continued storage.

4.15.6 Cumulative Impacts

Construction of a facility for any of the four agent destruction systems considered, and support structures, would remove or modify a maximum of 34 ha (85 acres) of terrestrial habitat with minor effects on wildlife. Routine, incident-free operation of the agent destruction facility would have negligible potential to impact ecological resources as the result of atmospheric emissions of pollutants either on- or off-post. Atmospheric dispersion modeling indicates that the total PCD air emissions of criteria pollutants, including those from operation of facility and all other PCD emissions, would be within ambient standards (see Sects. 4.7 and 4.8). Consequently, any cumulative impacts on terrestrial habitats and wildlife should be minor.

4.16 AQUATIC HABITATS AND FISH

This section describes the aquatic ecological resources of the existing environment and assesses the impacts on these resources from the construction and operation of the four agent destruction system alternatives under: the baseline incineration alternative, the modified incineration alternative, and the neutralization with SCWO or biotreatment alternative. Except for possible reductions in habitat for aquatic and wetland biota during and for a period of recovery after operations, no environmental impact differences to ecological resources were identified among the three agent destruction systems considered. The potential impacts from construction and operation on all ecological resources, terrestrial, aquatic, and wetland, are summarized in Table 4.28.

4.16.1 Affected Environment

Aquatic resources at PCD include species typically associated with ponds and creeks. The only permanent bodies of standing water on PCD are Lynda Ann Reservoir, the AWS Pond, and Spring Fed Pond located in the northeastern part of PCD (Fig. 4.14). Chico Creek is an intermittent stream located in the western portion of PCD. Boone Creek and Haynes Creek are also intermittent streams located in the eastern portion of PCD. They are typically dry during the summer (Rust and E-E Management 1996).

The largest water body on PCD is Lynda Ann Reservoir (surface area of about 18 acres), which is located near the southeastern portion of the munitions storage area within the Boone Creek drainage. Recharge of the reservoir is from surface drainage and a small upstream spring. Approximately 90% of the shoreline is covered by cattails and bulrushes. The reservoir provides recreational fishing opportunities for PCD personnel and the public. It is stocked periodically with channel catfish (*Ictalurus punctatus)* and stocked annually with cutthroat trout (*Salmo clarkii)*. The plains killifish (*Fundulus zebrinus)*, fathead minnow (*Pimephales promelas*), and brassy minnow (*Hybognathus hankinsoni*) were the most abundant species collected during seining (Rust and E-E Management 1996).

The AWS Pond is a 2-acre impoundment near the former TNT Washout Facility located in the southwestern portion of PCD, approximately 3.5 miles southwest of Munitions Storage Area A. In 1987, all fish were removed from the pond with rotenone. In 1988, the U.S. Fish and Wildlife Service (USFWS) stocked the pond with 36 southern redbelly dace (*Phoxinus erythrogaster)*, a Colorado state endangered fish species (Rust and E-E Management 1996). This species has become well established, as evidenced by the number of individuals captured by dip nets in 1995. A school of 750–1000 individuals was observed in the AWS pond on several occasions during 1995 (Rust and E-E Management 1996). The black bullhead (*Ictalurus melas)* also resides in this pond. The AWS Pond is not considered appropriate for fishing because of the possibility of introducing a bait species into the pond which may compete with, or prey on the dace.

The Spring Fed Pond or upper Boone Creek is about 0.1 acre in size and lies about one mile southeast of Munitions Storage Area A. The pond periphery is composed of cattails and bulrushes. Submergent vegetation is quite dense and includes algae (*Chara spp.)*, pondweed (*Potomogeton spp.)*, and coontail (*Ceratophyllum spp.)*. The most recently available information indicates that fathead minnows and brassy minnows, as well as the tiger salamander, reside in Spring Fed Pond (also known as Boone Creek Pond; FWS 2001). The same fish species likely occur at least occasionally in Boone Creek proper when flow is present. No information on species present in Haynes Creek was found. A few aquatic and semiaquatic invertebrates and possibly two or three species of small fish species such as the fathead and brassy minnows may occur in Haynes Creek during periods of adequate flow.

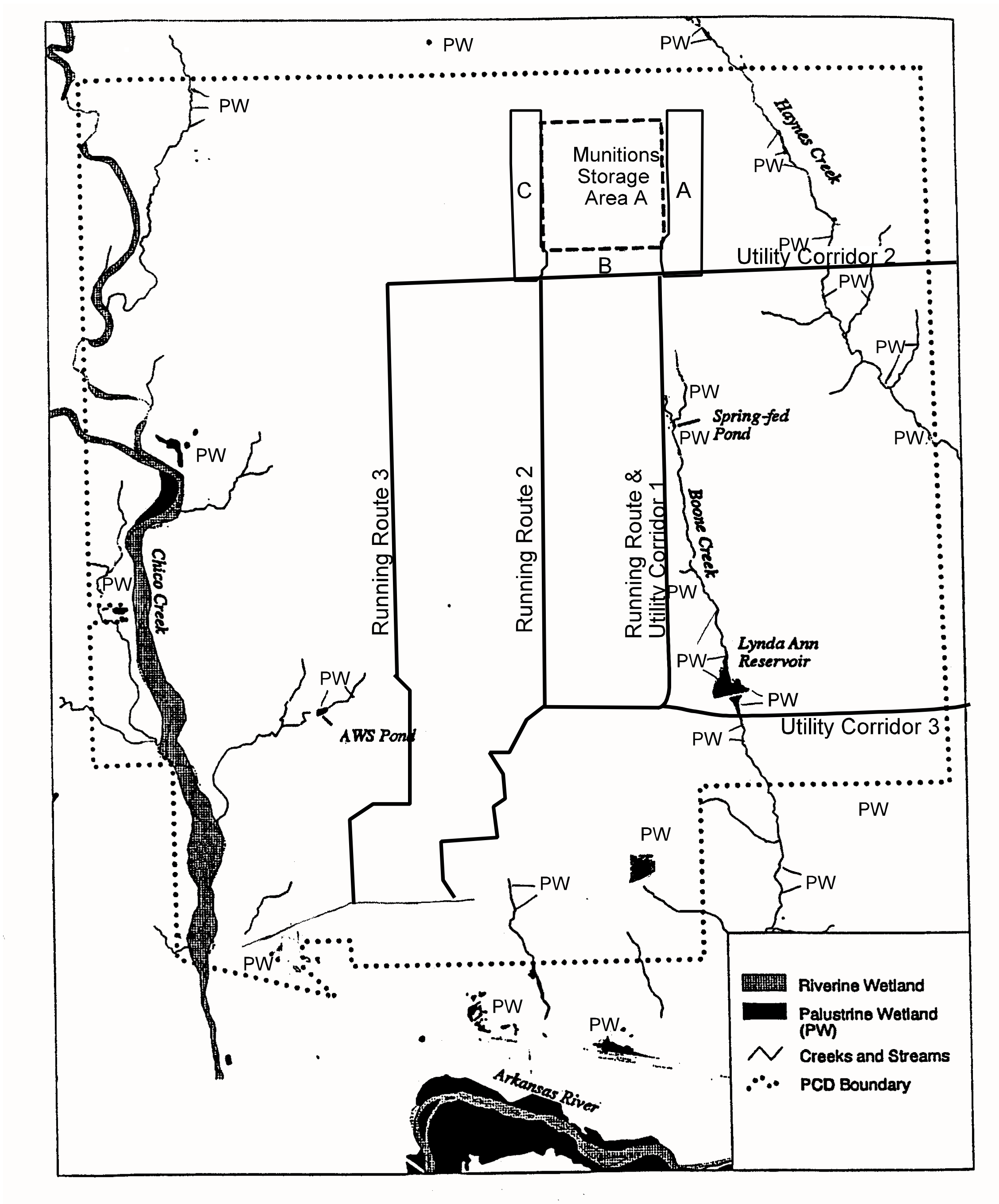


Fig. 4.14. Surface waters and wetlands at Pueblo Chemical Depot.
Source: PCD Environmental Database.

Chico Creek flows during spring snowmelt and after summer rains; low flows occur during the remainder of the year. Aquatic biota of Chico Creek are similar to those of other intermittent streams in semiarid ecosystems of the Great Plains. Wetland and aquatic vegetation in areas protected from grazing occur along the periphery of the creek. Green and blue-green algae and diatoms form mats on the surface of small pools within the creek during fall and winter. Native fish captured during seining of Chico Creek included mostly herbivorous, minnow species (Family Cyprinidae) that are typically small [i.e., typically less than 6 in. at adult size]. Fish species recorded included longnose dace (*Rhinichthys cataractae),* sand shiner (*Notropus stramineus),* bigmouth shiner (*N. dorsalis),* red shiner (*Cyprinella lutrensis),* plains minnow (*Hybognathus placitus*)*,* brassy minnow, fathead minnow, and central stoneroller (*Campostoma anomalum)*.

4.16.2 Impacting Factors

Impacting factors can arise from construction activities (e.g., , accidental spills and erosion resulting in entry of sediment and contaminant-laden runoff into surface waters), normal operations (e.g., emissions and effluents resulting in deposition or discharge of contaminants into area waters and a very slight chance of temporary [up to 33 months or so] reduction in surface water volume or flow from groundwater withdrawals), and accidents (i.e., the bounding case accidental release of mustard by the crash of an airplane into a storage facility followed by a fire).

4.16.3 Impacts of Construction

On-post. Direct and indirect construction impacts of the baseline or modified incineration alternative or the neutralization alternatives on aquatic ecological resources would not differ materially, i.e., impacts on aquatic biota would be of little or no consequence given implementation of best-management practices for erosion control and spill response.

Because surface water bodies and wetlands are absent from the proposed construction site, direct and indirect adverse effects of construction of any of the alternatives on aquatic ecosystems are unlikely. Nearby intermittent Haynes Creek (at least 5000 ft from the proposed facilities) and perennial Boone's Creek (more than 2000 ft from the facilities) could receive sediment- or spill-laden runoff during and immediately after rainfall, or following snowmelt, but implementation of best-management practices for erosion control and interception and treatment of minor spills should adequately protect these streams and their aquatic biota.

Off-post. Construction activities under the incineration or neutralization alternatives would not adversely affect aquatic resources off-post.

4.16.4 Impacts of Operations

4.16.4.1 Impacts of incineration alternatives

On-post. Generally the principal means by which routine operations of a facility of this nature could possibly adversely impact aquatic ecosystems are (1) deposition of atmospheric pollutants,(2) discharges of pollutant-laden effluents directly or indirectly into nearby surface waters, and (3) alterations in the hydrologic regime of area surface waters.

Previous screening level ecological risk assessments (SLERAs) conducted as part of the RCRA permitting process for the Tooele, Utah (A. T. Kearney, Inc. 1996), Umatilla, Oregon

(Ecology and Environment 1996), and Anniston (USACHPPM 1996) chemical demilitarization facilities concluded that adverse effects of atmospheric pollutant deposition on nearby aquatic ecosystems was, for the most part, unlikely. The total hazard index for emissions from the Umatilla facility, however, indicated a slight potential for effects on aquatic species in wetlands about 7 km from the facility boundary.

Similarly, an environmental impact risk analysis for the proposed Pine Bluff, Arkansas chemical munitions destruction facility, which is under construction, concluded that emissions would not adversely affect aquatic organisms of nearby water bodies (USACHPPM 1997). On the basis of these three studies, it is concluded that small streams and ponds downwind of the proposed facility, such as upper Boone Creek and its Spring Feed Pond, possibly could [but likely would not] receive sufficient deposition of emission contaminants to adversely affect some aquatic species during the period of operations. Other streams and ponds, such as Haynes Creek, Chico Creek, and the AWS Pond, would be even less likely to be affected.

A SLERA has yet to be performed for the PCD site. Due to differences in facility operation and design, local climate and meteorology, topography, receptor communities, etc., there is some uncertainty attached to the prediction of site-specific effects at one facility based on the study of another facility some distance away. However, the above multiple assessment results for several similar facilities, in concert with the low atmospheric emission rates for the proposed incineration alternative presented in Sections 4.7 and 4.8, strongly suggest that small streams and ponds downwind of the proposed facility would not receive sufficient deposition of emission contaminants to adversely affect aquatic species during the period of operations. All of the alternative chemical destruction systems would be expected to release even lower quantities of contaminants to the atmosphere, hence no measurable impacts on aquatic ecosystems would be expected to occur.

Once an alternative chemical destruction technology is selected, and before the selected alternative can be granted a RCRA permit, a site-specific SLERA will have to be performed in accordance with the new draft SLERA Protocol developed by the EPA (1999) in support of RCRA permitting for hazardous waste combustion facilities.

Temporary alterations in the hydrologic regime and water quality of area surface waters as a result of groundwater usage by the proposed facility are a slight possibility, less so for the modified incineration alternative than the baseline incineration alternative. The information currently available on the groundwater/surface water regime, however, is not sufficient to estimate the probability of this indirect effect, nor to identify which surface water bodies might be affected, nor to quantify the amount of reduction in flows, volumes, or water quality in the various surface waters (See Sect. 4.15.4: Impacts of Operations on Surface waters). As a consequence, there is a slight possibility that on-site streams and ponds, dependent to an unknown extent on groundwater discharge, would experience temporary low-to-moderate reduction in flows, water levels, or water quality as an indirect effect of groundwater withdrawals for the proposed facility. Such reductions would slightly reduce in turn the biotic carrying capacity of the affected surface waters for the duration of facility operation and for some time of recovery thereafter. Because the effects would not be permanent (a matter of a few years), and the aquatic organisms are not believed to be unique or unusual for this region, the impacts would be acceptable, with one possible exception. A remote possibility exists that groundwater usage could adversely affect the population of Colorado-listed endangered southern red-bellied dace that has become established in the AWS pond.

Off-post. As with on-post effects described above, small streams and ponds off-post and downwind of the proposed facility could [but likely would not] possibly receive sufficient deposition of emission contaminants to adversely affect some aquatic species, but off-post impacts, if any, would be less than those occurring on-post.

4.16.4.2 Impacts of neutralization alternatives

The annual groundwater consumption rate for the neutralization with SCWO alternative disposal system [24 ac-ft (including potable water requirements of 20 ac/ft)] would be 36% less than the consumption rate expected for the neutralization with biotreatment alternative (37 ac-ft), 46% less than for the modified incineration alternative (44 ac-ft), and about 52% less than for the baseline incineration alternative (50 ac-ft). As with the incineration alternatives, the neutralization alternatives would possibly exert a low to moderate, temporary, indirect effect on aquatic resources and their resident biota in the Boone Creek drainage through withdrawal of some groundwater that otherwise might contribute to local surface waters and wetlands. The two neutralization alternatives (one using biotreatment, the other using SCWO) would consume from 3 to 9% and 2 to 6%, respectively, of the annual inflow to the local aquifer. This compares with depletions of 3.7 to 11% and 4 to 13% for the modified and baseline incineration alternatives, respectively. Again, the duration of this impact would be limited for the most part to the period of operation, i.e., about 28-65 months, depending on the specific alternative technology selected.

4.16.5 Impacts of No Action

No new construction would be associated with the no action alternative; therefore, there would be no impacts from construction on aquatic habitats and biota. Continued storage of chemical agents at PCD would not adversely affect surface waters and their aquatic habitats and biota during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

4.16.6 Cumulative Impacts

Cumulative impacts of the incineration and neutralization alternatives are addressed separately in the following section.

4.16.6.1 Baseline incineration alternative

Implementation of the baseline incineration alternative would increase the current groundwater withdrawal rate at the PCD for potable and process water supply by about 50 ac-ft/year (i.e., from about 4.3 ac-ft/y to about 54 ac-ft/year). This incremental withdrawal rate from the alluvial aquifer represents between about 5% and 14% of the recharge rate for the aquifer; relatively minor and temporary adverse effects on surface water flow rates and water levels in streams and ponds overlying the aquifer are a slight possibility, along with associated relatively minor reductions in biotic carrying capacities of any affected water body for the duration of operations.

Other On-Post Activities. Any additional groundwater withdrawals for current or other future activities on-post would possibly exacerbate the potential minor, but temporary impacts on the hydrological regime of streams and ponds and their biota due to the proposed baseline incineration alternative.

Other Off-Post Activities. As with additional future on-post activities, any additional groundwater withdrawals for current or other future activities up-gradient but off-post would possibly exacerbate the potential minor, but temporary impacts on streams and ponds and their biota due to the proposed baseline incineration alternative.

4.16.6.2 Modified incineration alternative

As with the baseline incineration alternative, implementation of the modified incineration alternative would increase the current groundwater withdrawal rate at the PCD installation from about 4.3 ac-ft/year to 48 ac-ft/year. This withdrawal rate from the Verdose alluvial aquifer represents 4 to 12% of the inflow rate for the aquifer (400–900 ac-ft/year); minor, but temporary adverse effects on surface water flow rates and water levels in streams, ponds, and wetlands overlying the aquifer are a possibility, along with associated minor reductions in biotic carrying capacities of any affected water body for the duration of operations.

4.16.6.3 Neutralization alternatives

Under either neutralization alternative, atmospheric emissions would be quite low, and, like the incineration alternatives, the discharge of process and sanitary effluents would be zero or nearly so; no measurable adverse effects on aquatic biota would be expected to occur even when considered in the context of impacts from other past, present, and reasonably foreseeable future sources. The incremental increase in groundwater consumption due to neutralization with biotreatment (37 ac-ft/year) would be moderately less than the increase that would be expected under the baseline incineration alternatives (50 and 44 ac-ft/year, respectively), and higher than for neutralization/SCWO's 24 ac-ft/year.

The neutralization with biotreatment alternative would impose a predicted groundwater withdrawal rate of 37 ac-ft/year on the existing consumption rate of 4.3 ac-ft/year (potentially representing a cumulative 3.5 to 10% of the annual inflow to the local aquifer). Under the neutralization with SCWO alternative, cumulative withdrawals (4.3 + 24 acre-ft) would represent only from about 2.3 to 7% of annual groundwater inflow. Either neutralization alternative, therefore, would potentially have a somewhat less severe cumulative, adverse, and indirect effect on surface waters, and the aquatic animal and plant communities dependent on them, than the incineration alternatives. The duration of this impact, however, would be limited for the most part to the period of operation (i.e., from 28 to 65 months).

With the exception of the potential for additional, but temporary adverse effects on on-site aquatic biota from reduced discharge of groundwater into local surface waters, neither neutralization alternative would contribute much to cumulative adverse impacts on area aquatic ecosystems arising from other past, present, and reasonably foreseeable future actions.

4.17 PROTECTED SPECIES

4.17.1 Affected Environment

The information on threatened and endangered species is based largely on the ecological survey report for PCD prepared by Rust (1999), on surveys by Rust and E-E Management (1996), and on the Integrated Natural Resources Management Plan (Canestorp 2001). Informal consultation with the USFWS under the Endangered Species Act has been initiated through a request for a list of threatened, endangered, and proposed threatened or endangered species (Pentecost 2000a) which could inhabit or visit the PCD and could possibly be affected by construction of an agent destruction facility (Appendix F). A list of the protected species that may potentially occur in Pueblo County was received from USFWS (Carlson 2000) and the information has been incorporated into Table 4.30 (Appendix F). The Colorado Division of Wildlife was also contacted (Pentecost 2000b) with a request for information on state-protected species (Appendix F), and a response has been received (Kaczmarek 2000) and the information is represented in Table 4.30. The Colorado Natural Heritage Program database (Colorado State University 1999) was also used to determine sensitive species and plant communities possibly present. Table 4.30 provides information on all protected species and sensitive plant communities occurring at PCD in 1995 and 1997. The table reflects recent changes in status that occurred for some species since the survey report was published. It also lists protected species that were not observed during the surveys but may occur on PCD as occasional visitors or transients. No federally endangered or threatened animal or plant species are known to occur at PCD (Rust and E-E Management 1996; Rust 1999). A recovery program for the federally endangered black-footed ferret previously conducted by USFWS and PCD on the PCD site was unsuccessful and has been discontinued (personal communication, K. M. Canestorp, USFWS, to J. T. Ensminger, ORNL, February 6, 2001).

The mountain plover (*Charadrius montanus*), a federal proposed threatened species, occurs at PCD in shortgrass prairie habitats. Mountain plovers typically prefer sparsely vegetated areas or disturbed sites (Knopf 1996). Plovers were observed on overgrazed shortgrass prairie sites during the summer breeding season; they were located about 0.5 mile east of Lynda Ann Reservoir and approximately 3.0 miles southeast of Area A.

Two federal candidate species have been observed at PCD. The swift fox (*Vulpes velox*) and black-tailed prairie dog (*Cynomys ludovicianus*) both occur in shortgrass prairie habitats. A pair of swift foxes was sighted in northern sandhill prairie habitat in the Haynes Creek watershed about 2 miles southeast of Area A. Prairie dogs have been observed at several locations on PCD, typically in colonies of 3–15 individuals and up to thousands; these colonies have been affected by a plague epizootic in recent years (Canestorp 2001).

The burrowing owl, ferruginous hawk, northern harrier, black tern (*Chilidonias niger*), and loggerhead shrike (*Lanius ludovicianus*), due to decreases in density or habitat, are all considered federal sensitive species by the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service. The black tern and burrowing owl are migratory species that inhabit the PCD during the summer breeding season. The other three species are permanent residents and breed at PCD. The ferruginous hawk and burrowing owl were observed mostly in shortgrass prairie habitat, while the northern harrier was observed in all habitat types except riparian

Table 4.30. Federal and State protected species/sensitive communities observed and potentially occurring at the Pueblo Chemical Depot, Colorado[a]

Scientific Name	Common Name	Federal Status[a]	State Status[b]	CNHP Status[c]
Documented Occurrence				
Plants				
Asclepius uncialis	Dwarf milkweed	FS	—	S1, S2
Animals				
Vulpes velox	Swift fox	C	SC	S3
Zapus hudsonius preblei	Preble's meadow jumping mouse	LT	T	S1
Cynomys ludovicianus	Black-tailed prairie dog	C	SC	
Athene cunicularia	Burrowing owl	FS	T	S3B, S4B
Buteo regalis	Ferruginous hawk	FS	SC	S3B, S4N
Charadrius montanus	Mountain plover	PT	SC	S2B, SZN
Chilidonias niger	Black tern	FS	—	S3B, S4B, SZN
Lanius ludovicianus	Loggerhead shrike	FS	—	S3B, S4B, SZN
Rana blairi	Plains leopard frog	—	SC	S3
Rana pipiens	Northern leopard frog	FS	SC	S3
Phoxinus erythrogaster	Southern red-belly dace	FS	E	S1
Hybognathus placitus	Plains minnow	—	SE	SH
Hybognathus hankinsoni[d]	Brassy minnow[d]	—	T	—
Plant Communities				
Sarcobatus vermiculatus/ Sporabolus aeroides	Black greasewood/alkali socaton community	—	—	SU
Oligosporus filifolia/Andropogon hallii	Sand sagebrush/sand bluestem community	—	—	S2
Populus deltoides – Salix amygdaloides/Salix exigua	Plains cottonwood – Peachleaf willow/coyote willow community	—	—	S3
Symphoricarpos occidentalis	Snowberry community	—	—	S3
Not Observed at PCD but May Occur as Occasional Transients or Introduced Species				
Lynx canadensis	Canada lynx	LT	E	—
Mustela nigripes	Black-footed feret	LE	E	—
Srtix occidentalis lucida	Mexican spotted owl	LT	T	S1B, SU
Grus americana	Whooping crane	LE	E	S2N
Haliaeetus leucocephalus	Bald eagle	LT	T	S1B, S3N

Table 4.30. (Cont.)

Scientific Name	Common Name	Federal Status[a]	State Status[b]	CNHP Status[c]
Plegadis chihi	White-faced ibis	FS	—	S2B, SZN
Typanuchus pallidicinctus	Lesser prairie chicken	FS	T	S2
Sistrurus catenatus	Massasauga	—	SC	S2
Etheostonia cragini	Arkansas darter	C	T	S2
Fundulus sciadicus	Plains topminnow	FS	SC	S2
Machybopsis (Hybopsis) aestivalis tetranemus	Speckled chub (Arkansas River population)	FS	SC	S1
Bufo punctatus	Red-spotted toad	—	SC	S3, S4
Gaura neomexicana coloradensis	Colorado butterfly plant	PT	—	—

[a]C = federal candidate species: taxa for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened

FS = federal sensitive species: species considered to be sensitive by the U.S. Forest Service or U.S. Bureau of Land Management because of significant current or predicted downward trends in population numbers or density, or downward trends in habitat capability to support the species' existing distribution

LE = federal endangered

LT = federal threatened

PT = federal proposed threatened

[b]E = state endangered species

SC = state species of concern

T = state threatened species

[c]Colorado Natural Heritage Program

S1 = critically imperiled = critically imperiled in the state because of extreme rarity (five or fewer occurrences, or very few remaining individuals) or because of biological factors making the species vulnerable to extirpation from the state

S2 = imperiled = imperiled in the state because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extirpation from the state

S3 = vulnerable = rare in state (21 to 100 occurrences)

G3 = vulnerable throughout its range or found locally in S restricted range (21 to 100 occurrences)

G4 = apparently secure globally, although it might be quite rare in parts of its range, especially at its periphery

S1B= breeding season imperilment; not a permanent resident; extreme rarity

S2B= breeding season imperilment; not a permanent resident

S3B = breeding season vulnerable; not a permanent resident

S3N = non-breeding season vulnerable; not a permanent resident

S4B = breeding season imperilment; not a permanent resident

S4N = nonbreeding season secure; not a permanent resident

S3S4 = watch listed; specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted

SH = historically known from the state; not verified for an extended period

SU = unable to assign rarity, often because of low search effort or cryptic nature of the community

SX = unranked; some evidence that species may be imperiled, but awaiting formal rarity ranking

SZN = migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected

[d]Identification inclusive (U.S. Fish and wildlife Service 2001).

Sources: Rust and E-E Management (1996); Rust (1999); Colorado State University (1999); Kaczmarek (2000); Carlson (2000), Canestorp (2000). U.S. Fish and Wildlife Service 2001. Draft Integrated Natural Resource Management Plan-Pueblo Chemical Depot. FWS Colorado Field Office, Golden, Colorado.

woodland. Ferruginous hawks nested in a tamarisk tree in shortgrass prairie on the northeast portion of PCD. The black tern was observed two times during the summer at Lynda Ann Reservoir.

One fish introduced into the AWS Pond by the U.S. Fish and Wildlife Service, the southern red-belly dace (*Phoxinus erythrogaster*), is listed by the state of Colorado as endangered, and by the U.S. Forest Service and the BLM as a federal sensitive species. The plains minnow (*Hybognathus placitus*), collected from Chico Creek, is listed by the state of Colorado as endangered and the brassy minnow as threatened. Wetlands on the installation support populations of two frogs that are state-listed species of concern: the northern leopard frog (*Rana pipiens*) and the plains leopard frog (*Rana blairi*). The former is also listed by the U.S. Forest Service and the BLM as a federal sensitive species.

4.17.2 Impacting Factors

Impacting factors include construction activities, releases and spills, and accidents as discussed in the sections below.

4.17.3 Impacts of Construction

The following discussion presents the potential environmental consequences to protected species from siting and constructing an agent destruction facility under each of the four alternatives considered in this document: baseline incineration, modified incineration, neutralization with SCWO, and neutralization with biotreatment. Impacts of construction of an agent destruction facility under any of the four alternatives considered would be essentially the same due to the similarity in space requirements, construction activities, and durations for construction of the facilities associated with each.

Since no federal-listed threatened or endangered species are known to occur at PCD, they would not be affected by construction activities. Two federal candidate species (which are also state candidate species), the black-tailed prairie dog, and swift fox; and one federal proposed threatened species (which is also a state candidate species), the mountain plover; are known to occur in shortgrass prairie at PCD and could be affected by construction noise, the presence of construction crews, and habitat loss. A black-tailed prairie dog colony was observed during site visits in December 1999 and February 2000 in an area located about 0.25 mile southwest of Area C. Prairie dogs could be affected by construction activities occurring in the southern portion of Area C, particularly if construction equipment, parking areas, or laydown/assembly areas disturbed shortgrass prairie habitat within or immediately next to the active colony. Noise levels during construction periods and increased human activity would also affect prairie dogs.

The swift fox has been observed in shortgrass prairie along the east side of PCD. Fitzgerald et al. (1994) report that the swift fox occurs in shortgrass prairie throughout eastern Colorado in relatively flat to gently undulating topography. No information was found on the home range size of swift fox. The home range size for a similar species, the kit fox, is about 750 to 850 acres in Utah and 2200 to 2800 acres in Arizona (Zoellick and Smith 1992). When this size is used as a basis for swift fox home range, the amount of grassland and shrubland habitat that would be lost to a destruction facility would not be expected to adversely affect swift fox populations at PCD.

Although mountain plovers have not been documented in the vicinity of Areas A, B, or C, they have occurred during the breeding season on grazed shortgrass prairie communities in southeastern portions of PCD. Their occurrence suggests they could inhabit similar habitat next to the southern boundary of Area C. Noise and loss of habitat in the vicinity could adversely affect mountain plovers during the breeding season.

Federal sensitive species that could be affected by habitat loss from construction include the loggerhead shrike and the northern plains leopard frog. The loggerhead shrike would be affected by loss of shrubland habitat used for food and cover in Areas A and B. The leopard frog is known to occur in the Boone and Haynes Creek watersheds and would probably not be affected by loss of habitat resulting from the construction of an access road or the electric transmission line in Corridor 3. If an access road were constructed along this corridor, mitigation measures would be taken to avoid work in areas where standing water accumulates during rainy periods; such measures would reduce the potential for impacts on leopard frogs.

Neither the southern red-bellied dace, a Colorado state endangered species (which is also a federal sensitive species) inhabiting the AWS pond, nor the state-listed threatened brassy minnow residing in the spring-fed pond, would be affected by construction of facilities and infrastructure upgrades. No other state sensitive species are known to occur in northern portions of PCD in the three areas considered for siting facilities (Kaczmarek 2000).

4.17.4 Impacts of Operations

The following discussion presents the potential environmental consequences to protected species from operating an agent destruction facility under each of the four alternatives considered in this document: baseline incineration, modified incineration, neutralization with SCWO, and neutralization with biotreatment. Impacts of operating an agent destruction facilities under each of the four alternatives considered would be essentially the same.

No impacts to federally or state designated endangered, threatened, or candidate species would result from normal facility operations. Should groundwater be found to contribute significantly to the water budget for certain surface waters and wetlands, then groundwater usage possibly could adversely affect the population of Colorado-listed endangered southern red-bellied dace (which is also a federal sensitive species) that has become established in the AWS pond, the plains minnow which resides in other installation surface waters, and the plains and northern leopard frogs, both Colorado-listed species of concern, which reside in wetlands on the installation property.

4.17.5 Impacts of No Action

No new construction would be associated with the no action alternative, therefore, there would be no impacts from construction to federal- and state-listed species.

Continued operations under the no action alternative, i.e., storage of chemical agents at PCD, would not be expected to adversely affect any sensitive species in the vicinity of Munitions Storage Area A during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

Impacts of an accident on federal- and state-listed species associated with the no action alternative are discussed above in Sect. 4.18.5.

4.17.6 Cumulative Impacts

Construction of a facility for any of the four agent destruction systems considered, and support structures, would remove or modify a maximum of 85 acres of terrestrial habitat with minor effects on federal- and state-listed species. Routine, incident-free operation of the agent destruction facility would have negligible potential to impact these species as the result of atmospheric emissions of pollutants either on- or off-post. Atmospheric dispersion modeling indicates that the total PCD air emissions of criteria pollutants, including those from operation of any agent destruction facility alternatives and all other PCD emissions, would be within ambient standards (see Sects. 4.7 and 4.8). Consequently, any cumulative impacts on federal- and state-listed species from these sources should be minor. There is a very slight potential, however, that cumulative groundwater usage during operations could slightly to moderately reduce available aquatic and wetland habitat of the Colorado-listed endangered southern red-bellied dace and the Colorado-listed species of concern (the plains and northern leopard frogs). Such minor effects, should they occur at all, would be temporary.

4.18 WETLANDS

4.18.1 Affected Environment

Wetland surveys were conducted at PCD in June 1998 by using criteria developed by the USACOE (1987) for jurisdictional (i.e., naturally occurring) wetlands. On the basis of indicators set forth in the criteria for vegetative, soil, and hydrologic conditions that must be present for an area to be classified as a wetland, wetland sites were identified and mapped (Fig. 4.14). For a more detailed mapping and classification of wetlands within the PCD boundaries, see the National Wetlands Inventory Maps for the North Avondale, CO and Devine, CO quadrangles prepared by the U.S. Fish and Wildlife Service (FWS 1999). Table 4.31 shows acres of selected wetlands and water and total acres in each of the wetland types identified at PCD. According to the INRMP (FWS 2001), a total of 173 acres of palustrine and riverine wetlands lie within the PCD boundary, based on the 1999 FWS National
Wetlands Inventory map for the PCD area. Wetlands at PCD are commonly associated with ponds, seeps, and streams (Rust and E-E Management 1996). No wetlands occur on the proposed destruction facility site. Common plants occurring in PCD wetlands include cattails (*Typha latifolia, T. angustifolia)*, sedges (*Carex spp.)*, spikerushes (*Eleocharis spp.)*, rushes (*Juncus balticus, J. effusus)*, bulrushes (*Scirpus spp.)*, three-square bulrush (*Schoenoplectus pungens)*, skunkbrush (*Rhus aromatica trilobata)*, western snowberry (*Symphoricarpos occidentalis)*, and smooth scouring rush (*Equisetum hyemale)*.

4.18.1.1 Haynes Creek

A number of small wetlands occur within the portion of Haynes Creek watershed that traverses the northeast section of PCD. None of these wetlands exhibit characteristics typical of wetlands that surround open water. A total wetland area of 21 acres was documented at these locations (Rust and E-E Management 1996). Most sites had a single-stratum vegetative structure and showed impacts from grazing pressure such as soil compaction and trampled vegetation. Vegetation was not distributed in a zonal pattern that was observed elsewhere along drainage areas within PCD. Only 3.0 acres of open water was present at the five sites during

Table 4.31. Selected PCD wetland areas identified during the 1998 surveys

Site	Area (acres)[a]		
	Wetland	Water Surface	Total
Haynes Creek	21	3	24
Lynda Ann Reservoir	4.2	14	18
Boone Creek north of Lynda Ann Reservoir[b]	7.5	0.5	8
Boone Creek south of Lynda Ann Reservoir	2	0	2
Ammunition Workshop (AWS) Pond	0.3	0.5	0.8
Ammunition Workshop (AWS) Ditch	0.8	0	0.8
Hillside seeps	0.9	0	0.9
Chico Creek	No estimates	No estimates	No estimates
Total	36	18	54

[a]1 acre = 0.4 hectare.
[b]Includes acreage of wetlands around Spring Fed Pond.
Source: Rust (1999, unpublished draft ecological survey report for PCD).

the June 1998 surveys. Several wetlands occur in the Haynes Creek watershed northeast of the PCD boundary and beyond the eastern boundary. Some wetlands northeast of PCD within the Haynes Creek watershed are associated with livestock watering ponds on adjacent private property.

4.18.1.2 Lynda Ann Reservoir and Boone Creek

The Boone Creek watershed has several wetlands on PCD that total 13.7 acres. The largest contiguous wetland is associated with Lynda Ann Reservoir located about 3.5 miles south-southeast of Area A. An estimated 4.2 acres of wetlands and 14 acres of open water make up the Lynda Ann Reservoir. The wetlands in the Boone Creek watershed are downgradient from the well field immediately west of Munitions Storage Area A, and most probably receive some discharge from groundwater (see Sect. 4.18.1.3 below). A multilayered vegetative structure is present; plains cottonwood (*Populus deltoides)* dominates the canopy. Coyote willow (*Salix exigua)* is in the mid-canopy layer, and great bulrush (*Scirpus validus)* and yellow sweet clover (*Melilotus officinalis)* make up the dominant vegetation in the herbaceous layer. Three wetlands totaling 7.5 acres occur in the Boone Creek drainage above Lynda Ann Reservoir. Two of the wetlands have multilayered vegetative communities. Common species at these locations include the plains cottonwood, tamarisk (*Tamarix sp.*), greasewood, and great bulrush.

4.18.1.3 Seepage areas

Numerous seepage areas occur along bluffs of drainage ways at PCD. These areas were estimated to include about 0.9 acre of wetlands vegetation. These wetlands are located in the northwestern portion of the PCD, downstream of Lynda Ann Reservoir, downgradient of the pond near the remediation facility, and in the southwestern corner of PCD. Just south of the PCD boundary, several seeps occur along bluffs above the Arkansas River Valley (Rust and E-E Management 1996). A 2-acre spikerush-dominated wetland is located about 0.5 mile south of Lynda Ann Reservoir. Most of the wetland vegetation at this location was destroyed or damaged by cattle grazing in late summer and fall of 1997. The vegetative zones in seep wetlands consist of saltgrass (*Distichlis spicata)*, saltgrass/rushes, three-square bulrush, and cattails/bulrushes. Ground cover is nearly 100% in many seep areas, which range in size from a few square feet to irregularly shaped strips along a bluff that are 200–300 ft long.

4.18.1.4 Chico Creek

Wetland areas associated with the Chico Creek watershed include vegetation around shallow pools, in old bends, and in high water channels. During 1995, lower portions of Chico Creek on PCD that had been heavily grazed were eroding. Common riparian wetland vegetation found there includes cattails, great bulrush, three-square bulrush, spikerush, coyote willow, and scouring rush. The southern portions of Chico Creek are characteristically flatter and contain more open floodplain and braided channel. The development of wetland vegetation is limited by stream scouring during occasional high flows. Dominant species include cattails, great bulrush, three-square bulrush, and coyote willow.

4.18.2 Impacting Factors

Impacting factors can arise from construction activities (e.g., accidental spills and erosion resulting in entry of sediment and contaminant-laden runoff into wetlands), normal operations (e.g., emissions and effluents resulting in deposition or discharge of contaminants into area wetlands; temporary reduction in wetland water volume or flow as a result of groundwater withdrawals), and accidents (i.e., the bounding case accidental release of mustard by the crash of an airplane into a storage facility followed by a fire).

4.18.3 Impacts of Construction

Construction impacts of the incineration or neutralization alternatives would not be notably different among the four alternatives.

On-Post. Wetlands are absent from the proposed sites (Areas A, B, and C) for the destruction facility. No direct or indirect effects on wetlands from construction of the destruction facility would be expected. The nearest wetlands downgradient from the proposed sites for the destruction facility comprise a group of small wetlands approximately 0.9 mi from Area A. One of these wetlands, a spring-fed pond (Fig. 4.14), is bermed and receives no inflow from other streams. Runoff from construction activities would be contained, if necessary, by using standard erosion control measures.

Construction/widening of Running Routes 2 and 3 and combined Running Route and Utility Corridor 1 would avoid direct adverse effects to nearby wetlands (Fig. 4.14). Utility

Corridors 2 and 3 would probably cross small palustrine wetlands along Haynes Creek and pass within a few hundred feet of other small wetlands.

Off-post. Construction activities under any of the four alternatives would not adversely affect wetland resources off-post.

4.18.4 Impacts of Operations

4.18.4.1 Baseline incineration alternative

On-post. Wetlands and their biota would be subject to the same potential sources of impacts as the non-wetland surface waters and their biota discussed above. Thus there would be a slight possibility that wetlands downwind of the proposed facility could receive sufficient deposition of emission contaminants to adversely affect some aquatic species during the period of operations (see Sect. 4.17.4).

As would be the case with the aquatic resources, should on-site wetlands be partially dependent on recharge from groundwater, they could experience reductions in groundwater input with a consequent temporary slight reduction in biotic carrying capacity as an indirect result of groundwater withdrawal during operation of the proposed facility. All wetland biota could possibly be affected, but two frogs in particular that occur at PCD, the plains leopard frog and the northern leopard frog, are listed as species of concern by the state of Colorado. The northern leopard frog is also listed as a federal sensitive species by the U.S. Forest Service and/or the U.S. Bureau of Land Management. It should be underscored that, on the basis of current knowledge , the potential effects of existing and proposed groundwater usage on wetlands can not be quantified.

Off-post. Off-post wetlands downwind of the proposed facility could possibly receive sufficient deposition of emission contaminants to adversely affect some wetland species (see Sect. 4.17.4).

4.18.4.2 Modified incineration alternative

On-post. Impacts of operations, both direct and indirect, under the modified incineration alternative on wetlands would be essentially the same as for the baseline incineration alternative, set forth above, except that possible reductions in groundwater discharge to wetlands would be slightly lower than expected under the baseline incineration alternative. That is, (1) there would be a slight possibility that wetlands downwind of the proposed facility could receive sufficient deposition of emission contaminants to adversely affect some aquatic species during the period of operations. (See Sect. 4.17.4), and (2) on-site wetlands partially dependent on discharge from groundwater could experience minor reductions in groundwater input with a consequent reduction in biotic carrying capacity as an indirect result of groundwater withdrawal.

Off-post. As with the proposed baseline incineration alternative, wetlands off-post and downwind of the proposed facility could possibly receive sufficient deposition of emission contaminants to adversely affect some wetland biota.

4.18.4.3 Neutralization alternative

Under the neutralization with biotreatment alternative, the incremental increase in groundwater consumption would be moderately lower than the increase that would be expected under both incineration alternatives (moderately higher than for modified incineration, moderately lower than for baseline incineration). Consequently, the potential for moderate, indirect adverse impacts on wetlands and their biota from groundwater-usage induced alterations in surface hydrologic regimes would be somewhat lower than that for the incineration alternatives.

The neutralization with SCWO alternative, with a predicted groundwater withdrawal rate of 24 ac-ft/year (potentially representing from 2 to 6% of the annual inflow to the local aquifer) would therefore require about 36% less groundwater than needed for the neutralization with biotreatment alternative. The neutralization with SCWO alternative, therefore, would be less likely to exert an adverse indirect effect on wetlands, and the wildlife and plant communities dependent on them. Again, the duration of this impact would be limited for the most part to the period of operation (i.e., between two and three years).

The transport of atmospheric pollutants under either neutralization alternative into local wetlands would probably be negligible. Adverse effects on wetlands from this source would therefore be insignificant.

4.18.5 Impacts of No Action

No new construction would be associated with the no action alternative; therefore, there would be no impacts from construction on wetlands and their biota. Continued storage of chemical agents at PCD would not adversely affect wetlands and their biota during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

4.18.6 Cumulative Impacts

Cumulative impacts of the incineration and neutralization alternatives are presented separately in the following sections.

4.18.6.1 Baseline incineration

Other On-Post Activities. Any additional groundwater withdrawals for other future activities on-post would tend to exacerbate the potential minor impacts on the hydrological regime of wetlands and their biota due to the proposed baseline incineration alternative.

Implementation of the baseline incineration alternative would increase the current groundwater withdrawal rate at the PCD for potable and process water supply by about 50 ac-ft/year (i.e., from about 4 ac-ft/year to about 54 ac-ft/year). This incremental increase in withdrawal rate from the alluvial aquifer represents a possibly significant fraction (between about 5% and 14%) of the recharge rate for the aquifer. However, the minor adverse effects on surface water flow rates and water levels in streams, and ponds, overlying the aquifer are unquantifiable with the data currently available, but possible, along with associated minor reductions in biotic carrying capacities of any affected wetlands for the duration of operations.

Two state-listed species of concern, the plains and northern leopard frogs, possibly may experience temporary (i.e., for a few years) population declines in any wetlands indirectly affected by groundwater withdrawals.

4.18.6.2 Other off-post activities

As with additional future on-post activities, any additional groundwater withdrawals for other future activities up-gradient but off-post would tend to temporarily worsen the low-to-moderate impacts on wetlands and their biota due to the proposed baseline incineration alternative.

4.18.6.3 Modified incineration alternative

The same kinds of cumulative impacts addressed in the discussion of aquatic ecology under the baseline incinerator alternative above could occur in wetlands as well, only of slightly less magnitude. Two state-listed species of concern, the plains and northern leopard frogs, possibly would experience modest, temporary population declines in any wetlands indirectly affected by groundwater withdrawals.

4.18.6.4 Neutralization alternatives

Under either neutralization alternative, atmospheric emissions would be quite low, and, like the incineration alternatives, the discharge of process and sanitary effluents would be zero or nearly so; no measurable adverse effects on local wetlands and their biota would be expected to occur even when considered in the context of impacts from other past, present, and reasonably foreseeable future sources.

The incremental increase in groundwater consumption under the neutralization with biotreatment alternative (37 acre-ft/year) would be moderately less than the increase that would be expected under both incineration alternatives.

It should be noted that not only does neutralization with SCWO have a lower annual water requirement (24 acre-ft/year, or less than half that required annually by baseline incineration), but that operations are expected to be completed in only 28 months, compared to as much as 65 months for the other alternative technologies. Thus, based on available predictions of water use, for the operational life of each alternative, neutralization with SCWO would require a total of about 55 acre-ft, while baseline incineration, modified incineration, and neutralization with biotreatment would require approximately 270, 110, and 113 acre-ft, respectively (Table 4.27).

The neutralization with biotreatment alternative would impose a predicted groundwater withdrawal rate of 37 ac-ft/year on the existing consumption rate of 4.3 ac-ft/year (potentially representing a cumulative 3.5 to 10% of the annual inflow to the local aquifer). Under the neutralization with SCWO alternative, cumulative withdrawals would represent from about 2.3 to 7% of annual groundwater inflow. Either neutralization alternative, therefore, in concert with other existing groundwater withdrawals, would potentially exert a cumulative, but modest adverse, indirect effect on nearby surface waters and wetlands, and the wildlife and plant communities dependent on them. Were both incineration and neutralization facilities to be constructed and operated at the same time, then up to 23% of the estimated aquifer recharge rate would be consumed for process and potable water needs, although probably for a shorter time. This amount of withdrawal would represent a possibly moderate to substantial, but temporary, impact on the local groundwater resource, and to a somewhat lesser extent, therefore, on local surface waters and the wetland communities dependent on them as well. The duration of this impact, however, would be limited for the most part to the period of operation (i.e., about 28 to 65 months).

With the exception of a potential for additional, but temporary adverse effects on on-site wetland biota from reduced discharge of groundwater into local surface waters and wetlands, neither neutralization alternative would be expected to contribute substantially to adverse impacts on area wetlands arising from other past, present, and reasonably foreseeable future actions.

4.19 CULTURAL RESOURCES

4.19.1 Affected Environment

4.19.1.1 Archaeological resources

Between 1994 and 1996, approximately 11,330 acres of PCD were surveyed for archaeological sites (Fig. 4.15) to determine their eligibility for listing on the National Register of Historic Places (National Register). Forty-five sites and 128 isolated finds[3] were recorded in the surveys. Three sites—5PE1719, 5PE1930, and 5PE2093—were recommended as eligible for listing on the National Register; however, further testing was recommended for 32 of the sites (Larson and Penny 1995; FEC 1998).

More than 80% of the archaeological sites recorded (37 of 45) are located along Chico, Boone, and Haynes creeks, within or near the edges of the creek valleys (Larson and Penny 1995; FEC 1998). These sites are predominantly lithic scatters containing flaked stone debris and tools and small, open camps with evidence of possible features such as hearths. The majority of sites date between the Late Archaic Period (1000 B.C. to 100 A.D.) through the Middle Ceramic Period (1000 to 1550 A.D.). Two localities contain artifacts dating as early as the Late Paleo-Indian Period (8000 to 5500 B.C.). Additional prehistoric sites may be present in the unsurveyed portions of PCD.

The areas north and east of Munitions Storage Area A were surveyed for archaeological resources (Larson and Penny 1995; FEC 1998). Seven sites and nine isolated finds were recorded within the immediate vicinity of the potential project site (in Sections 2 and 3 of T.20 S and R.22 W and Sections 34 and 35 of T.19 S and R.22 W). None of these sites is eligible for National Register listing (U.S. Army et al. 1997).

Survey results indicate that there are few archaeological sites pertaining to the historic period at PCD, and none of the recorded sites has been directly attributed to the ethnohistoric period. The three historic sites that have been recorded at PCD date between 1880 and 1942 (when the property was acquired by the U.S. government). Twelve of the isolated finds are historic, consisting of glass or historic ceramic shards. Additional testing of one site (5PE1735) was recommended. This site, which has visible foundations, appears to have been part of an

[3]Finds are defined as one stone tool, five or fewer pieces of lithic debris or a single historic artifact type (e.g., glass or ceramic), or a scatter of glass or ceramics where all the shards appear to be from the same vessel.

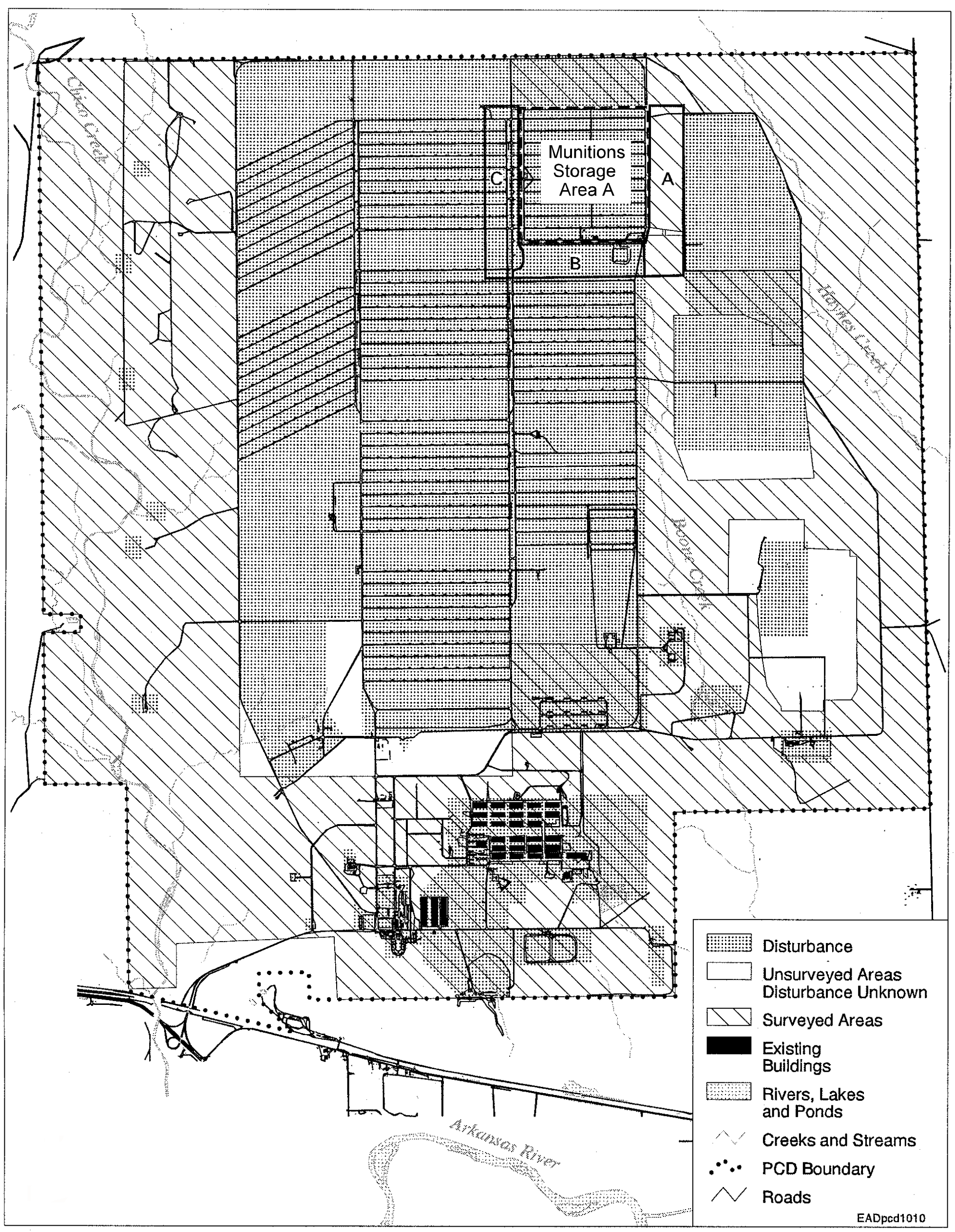


Fig. 4.15. Areas of Disturbance and Archaeological Survey at Pueblo Chemical Depot. *Source:* Larson and Penny, 1995; 1998; Montgomery, 1984; Aerial Photos, 1995.

early twentieth century ranch. The other historic archaeological resources were considered not eligible for the National Register (Larson and Penny 1995; FEC 1998).

4.19.1.2 Traditional cultural properties

A traditional cultural property (TCP) is a place that is eligible for inclusion on the National Register "because of its association with cultural practices and beliefs that 1) are rooted in the history of a community, and 2) are important to maintaining the continuity of that community's traditional beliefs and practices" (Parker 1993). No TCPs are known to exist within the proposed project site or its immediate vicinity.

4.19.1.3 Historic structures

A survey and evaluation of historic structures at PCD was initially completed in 1984 (McDonald and Mack Partnership 1984). The result of this assessment of 27 buildings was that none of them was eligible for listing on the National Register (U.S. Army et al. 1997). The Colorado State Historical Preservation Officer (SHPO) found this assessment inadequate and recommended that all structures on PCD be reevaluated. In 1998, a second survey of historic structures at PCD was finalized (Simmons and Simmons 1998). The report concluded that four districts and one building on PCD were potentially eligible for listing on the National Register. The districts included one World War II district (consisting of earthen-covered igloos, aboveground igloos, warehouses, and administration and support buildings) and three Cold War era districts: Hi Pardner Park, the Pershing missile demilitarization area, and the nuclear weapons storage area (within J-Block). Building 1, the post headquarters, was the only individual building recommended as being eligible for the National Register (Simmons and Simmons 1998).

A programmatic agreement (PA) signed in 1997 by the U.S. Army, the Colorado SHPO, the Advisory Council on Historic Preservation, and the Pueblo Depot Activity Development Authority indicates that the recommendations of the draft report (the draft was submitted in 1996) are acceptable and that the above-mentioned building and districts are eligible for listing (U.S. Army et al. 1997). The PA also states that the structures in Munitions Storage Area A, which house part of the nation's chemical weapons stockpile, are eligible for the National Register (U.S. Army et al. 1997). These structures have been adequately documented (mitigated) per the stipulations of the 1997 PA, and further review of potential impacts to these structures by the SHPO is not required.

4.19.2 Impacts of Construction

Archaeological, cultural, and historic resources could be affected by ground disturbance during construction of the proposed facility. There would be no notable differences in impacts among the incineration and neutralization alternatives because they would all involve similar amounts of ground disturbance.

Archaeological Resources. On the basis of previous survey results and the high level of existing ground disturbance in the proposed project site, construction of the chemical destruction facility, including the establishment of a staging area and construction of a power corridor and any additional access routes, is not likely to adversely affect eligible archaeological resources. None of the seven archaeological sites recorded within the immediate vicinity of the project site (see Sect. 4.20.1.1) is eligible for National Register listing. Therefore, construction of the destruction facility in the area east of Munitions Storage Area A would not affect significant archaeological resources.

Although construction would not result in significant impacts to archaeological resources, additional consultation would be required. The Army has initiated consultation with the Colorado SHPO under the provisions of Section 106 of the National Historic Preservation Act. In the event that previously unidentified cultural material is encountered during ground-disturbing activities, construction would cease immediately, and the Colorado SHPO and a qualified archaeologist would be consulted to evaluate the significance of the cultural artifacts.

Traditional Cultural Properties. No TCPs have been identified on or near the proposed project site. Given the results of previous cultural resource surveys and the high level of existing ground disturbance in the project area, construction of the chemical agent destruction facility is not likely to adversely affect any unidentified TCPs. However, although no TCPs have been identified, consultation with interested Native American governments regarding the proposed action will be conducted. The Army has contacted the Tribes to determine the presence or absence of TCPs on or near PCD.

Historic Structures. Based on the results of the historic structures surveys for PCD (Sect. 4.20.1.3), it is not likely that construction of the baseline incineration facilities would adversely affect eligible historic resources. The structures within Munitions Storage Area A have been determined to be eligible as a National Register historic district; however, these facilities have been sufficiently mitigated per the stipulations of the 1997 PA, and further review of potential impacts to these structures by the SHPO is not required (U.S. Army et al. 1997).

4.19.3 Impacts of Operations

Archaeological Resources. Routine operation of the destruction facility would not involve ground-disturbing activities and, therefore, likely would not adversely affect eligible archaeological resources at PCD.

Traditional Cultural Properties. Routine operation of the destruction facility likely would not adversely affect any unidentified TCPs at PCD.

Historic Structures. Routine operation of the destruction facility would not involve ground-disturbing activities and, therefore, likely would not adversely affect eligible historic structures at PCD. The bunkers in the Munitions Storage Area A Historic District are used to store the weapons stockpile from which munitions would be removed during operation of the proposed facilities; however, any impacts to these structures have been mitigated under the terms of the 1997 PA.

4.19.4 Impacts of No Action

The no action alternative would not affect cultural resources beyond the status quo in the areas surrounding Munitions Storage Area A. Chemical munitions that might otherwise be removed and destroyed would continue to be stored in the Munitions Storage Area A Historic District. Such use is compatible with the history and origin of the storage bunkers and has been mitigated according to the requirements of the 1997 PA.

4.19.5 Cumulative Impacts

The construction and operation of chemical agent destruction facilities using either incineration or neutralization technologies could combine with other past, present, and future actions to create cumulative impacts to on-post cultural resources. The other actions most likely to contribute to cumulative impacts would be ground-disturbing activities or building upgrades/construction associated with the land uses identified in the *Reuse Development Plan Update* (PDADA 2000a). However, because most of these uses would occur in existing buildings within previously disturbed areas, and because chemical agent destruction activities would be confined to a separate previously disturbed area, it is expected that cumulative impacts to on-post cultural resources would not be significant. Because activities associated with construction and routine operations would be confined to PCD, the contribution of these activities to cumulative impacts on off-site cultural resources would be negligible.

4.20 SOCIOECONOMICS

4.20.1 Affected Environment

For socioeconomics, the affected environment is Pueblo County because more than 90% of PCD's current work force resides in the county and it is likely that the direct and indirect impacts of employment, population growth, and expenditures associated with chemical agent destruction would be concentrated in the county. The only notable exception to this would be with accidental releases of mustard agent into the atmosphere, which could affect socioeconomic resources in several surrounding counties (see Sect. 4.22.14).

Population. In 1999, the population of Pueblo County was 136,987 and projected to reach 140,300 by 2001 (ANL 2001a) (Table 4.32). Of the 1998 county population, 107,301 (nearly 80%) reside in the city of Pueblo, with 110,700 people expected to be living in the city by 2001 (ANL 2001a). Boone (380 persons in 1998), the only other incorporated community in the vicinity of the installation, is located immediately southeast of PCD.

Table 4.32. City of Pueblo and Pueblo County population[a]

	1990	1999	Average Annual Growth Rate 1990-1999 (%)	2001 (projected)
City of Pueblo	98640	107,301[b]	0.6	110700
Pueblo County	123,051	136987	1.0	140300

[a]ANL 2001a.
[b]1998 data.

Employment. In 1997, total employment in Pueblo County was 45,227 and projected to reach 52,100 by 2001 (ANL 2001a). The county's economy is dominated by the trade and service industries, with employment in these activities currently contributing nearly 70% of all employment (Table 4.33). The construction sector showed the highest employment growth (more than 10%) between 1990 and 1997, and provided 7% of all jobs in the county in 1997 (U.S. Bureau of the Census 1999c).

Employment at PCD has been stable over the last 5 years, with 150 government employees working at the installation (Marrero 2000). More than 90% of these workers currently reside in Pueblo County. In addition, approximately 25 contractors and several military personnel work at PCD, and reuse tenant employment is currently 30 people (Oburn 2000).

Unemployment in Pueblo County declined steadily after the 1980s, when it averaged more than 10%, to a rate averaging almost 6.5% during the 1990s (ANL 2001a). Unemployment in the county is currently 4.3%, compared with 2.1% for the state (U.S. Bureau of Labor Statistics 2000).

Income. In 1997, total personal income in Pueblo County was $2.7 billion and projected to reach $3.5 billion in 2001 (ANL 2001a). County per capita income also rose in the 1990s, and was projected to reach $24,900 in 2001 (ANL 2001a).

Table 4.33. Pueblo County employment by industry

	1990		1997		Average Annual Growth 1990-1997 (%)
	Number Employed	Percent of County Total	Number Employed	Percent of County Total	
Agriculture	1,421[a]	4.0	1,460	3.2	0.5[b]
Mining	14	0.0	26	0.1	9.3
Construction	1,602	4.5	3,221	7.1	10.5
Manufacturing	5,656	16.0	5,153	11.4	(1.3)
Transportation and Utilities	1,415	4.0	1,903	4.2	4.3
Trade	10,695	30.3	14,223	31.4	4.2
Finance, Insurance, and Real Estate	1,350	3.8	1,828	4.0	4.4
Services	13,155	37.2	17,404	38.5	4.1
Total	35,351		45,227		3.6

[a]1992 data.
[b]Data for the period 1992-1997.
Sources: USDA 1999a; USDA 1999b; U.S. Bureau of the Census 1992; U.S. Bureau of the Census 1999c.

Housing. Housing stock in Pueblo County grew at an annual rate of 1.2% over the period 1990–2000 (Table 4.34) (U.S. Bureau of the Census 1999b). The total number of housing units was projected to reach 58,000 in 2001 (ANL 2001a), reflecting the relatively slow growth in county population. Growth in the city of Pueblo was slightly lower (1.1%), and the total number of housing units was projected to reach 45,900 in 2001 (ANL 2001a). More than 6,400 new units were added to the existing housing stock in the county during this period, of which almost 4,500 were constructed in the city of Pueblo (ANL 2001a).

Vacancy rates in 2000 were 6.2% in the city and 7.5% in the county as a whole for all types of housing (ANL 2001a). On the basis of annual population growth rates, 4,400 vacant housing units were projected for the county in 2001, of which 1,300 were projected to be rental units (ANL 2001a). However, the Pueblo Depot Activity Development Authority reports that there were only 3,700 vacant units (excluding seasonal and recreational units) in Pueblo County in 2000 (PDADA 2001).

Schools. Public education in the city of Pueblo is provided by School District No. 60; in the rest of Pueblo County it is provided by School District No. 70. District No. 60 consists of 21 elementary schools, seven middle schools, and five high schools, with a 1999 total enrollment of

Table 4.34. City of Pueblo and Pueblo County housing characteristics

Type of Housing	1990[a]	2001[b]
City of Pueblo		
Owner-occupied	24,837	27900
Rental	13,487	15100
Unoccupied	2,538	2,800
Total Units	40,862	45800
Pueblo County		
Owner-occupied	31,946	36400
Rental	15,111	17200
Unoccupied	3,815	4400
Total Units	50,872	58000

[a]U.S. Bureau of the Census 1992.
[b]Projected by Argonne National Laboratory (ANL 2001a).

17,564 students. There are also 12 non-public schools in the city of Pueblo, with a 1999 total enrollment of 938 students. District No. 70 consists of eight elementary schools, seven middle schools, and four high schools, with a 1999 total enrollment of 6845. In 1998, both districts had relatively low pupil/teacher ratios, with 16.7 pupils per teacher in District 60 and 18.8 pupils per teacher in District 70.

In the 1996-1997 school year, District No. 60 operated with a budget surplus ($93 million in revenues to cover $90.9 million in expenditures) while District No. 70 operated with a budget deficit ($30.5 million in revenues to cover $40.9 million in expenditures) (Colorado Department of Education 2000).

Public Services. In Pueblo County, public services are provided by a combination of local governments and private entities. Five rural water districts and two metropolitan districts (areas in which three or more public services are available) supply water to residents of Pueblo County. The Arkansas and Colorado River basins are the sources of drinking water for the city of Pueblo. The Pueblo Board of Water Works has a pumping capacity of 80 million gal/day (mgd). Average demand is approximately 23 mgd, and peak demand is approximately 60 mgd (U.S. Army 1997).

The City of Pueblo's sewage treatment plant has a capacity of 19 mgd, with an average demand of 13.5 mgd and a peak demand of 15.4 mgd. The city of Boone and the Avondale Water District each operate two sewage treatment lagoons (PMCD 1997).

The City of Pueblo employs 236 sworn police officers. The Pueblo City Fire Department provides emergency medical services through its rescue units. All fire fighters have emergency medical technician training and the 12 pumper trucks serve as emergency medical service vehicles. The Pueblo Hazardous Materials Response Team, a collective of trained hazardous materials responders mostly from fire departments, is responsible for handling hazardous materials emergencies.

The Pueblo County Sheriff's Department maintains a patrol and investigative force of 187 sworn officers. The Sheriff's Department serves areas of Pueblo County outside the city of Pueblo, but does not serve PCD. The Beulah, Boone, Edison, Fowler, Pueblo Rural, Pueblo West, Rye, and West Park volunteer fire departments provide fire protection in their respective towns or districts, but much of the unincorporated part of the county is without fire protection.

There are two hospitals with a total of more than 700 beds in Pueblo County. Parkview Episcopal Medical Center has a capacity of 305 and an occupancy rate of around 50%. Centura Health-St. Mary-Corwin Regional Medical Center has a capacity of 408 and an occupancy rate of around 50% (City of Pueblo 2000).

Public Finances. Sales taxes in the city of Pueblo currently amount to 7.5%; they include a city tax of 3.5%, a county tax of 1%, and a state tax of 3%. There is also a 4.3% local tax on lodging and a combined state and federal tax on gasoline and diesel fuel. Property taxes in the city amount to 29% of total assessed value for commercial property and vacant lots, and 9.74% of total assessed value for residential property (City of Pueblo 2000). Table 4.35 presents data on 1998 revenues and expenditures for the City of Pueblo and Pueblo County.

Transportation and Traffic. Vehicular access to PCD is from U.S. Highway 50, which links the installation with the city of Pueblo and Pueblo Airport to the west and with smaller communities to the east. Other roads used by employees working at PCD include State Route 96, which intersects with U.S. 50 south of PCD and runs east through North Avondale to the community of Boone. Business Route 50 intersects with U.S. 50 and runs west through Avondale toward Pueblo. North Avondale Boulevard connects North Avondale with Avondale.

Table 4.36 lists average annual daily traffic and congestion levels [Level-of-Service (LOS)] over these road segments. LOS designations, which were developed by the Transportation Research Board (1985), range from "A" to "F." LOS A through LOS C represents good traffic conditions with some minor delays experienced by motorists. LOS F represents jammed roadway conditions. Table 4.36 indicates that all road segments have LOS A except for one, which has LOS B.

Table 4.35. Local government finances (millions of 1998 $)

	City of Pueblo	Pueblo County
Revenues		
Taxes	47.3	24.9
Licenses and permits	0.2	0.1
Intergovernmental	2.3	4.5
Charges for services	0.3	3.1
Fines and forfeits	0.8	0.1
Miscellaneous	0.8	2.4
Total	51.7	35.1
Expenditures		
Public safety	20.2	12.6
General government	5.1	14.5
Highways and streets	2.5	1.2
Health, welfare, and	3.3	2.7
Culture and recreation	2.8	0.3
Intergovernmental	2.2	0.3
Other	3.0	2.0
Total	39.1	33.6
Revenues minus expenditures	12.6	1.5

Sources: City of Pueblo 1999; Pueblo County 1999.

Agriculture. Agriculture is the primary land use in Pueblo County. In 1997, the county contained 357,171 ha (822,584 acres) of farmland, the vast majority of which [320,779 ha (732,658 acres)] was used for pastureland, with only 36,392 ha (89,926 acres) used for cropland (USDA 1999b). The market value of agricultural products sold in Pueblo County in 1997 was approximately $33.6 million; of this total, approximately $19.4 million was for livestock and $14.2 million was for crops (USDA 1999b).

4.20.2 Destruction Impacting Factors

The primary impacting factor for socioeconomics would be the direct employment associated with facility construction and operations. As discussed in Sects. 4.21.3 and 4.21.4 below, this direct employment would result in direct income which would be spent in the local economy. These expenditures, in turn, would create indirect employment and indirect income.

Table 4.36. Average annual daily traffic in the vicinity of the Pueblo Chemical Depot

Road Segment	AADT	Level of Service[a]
U.S. 50 east of Pueblo Airport	12,800	B
U.S. 50 west of SR 96	6,300	A
U.S. 50 north of BR 50	3,600	A
U.S. 50 east of Avondale	4,750	A
BR 50 east of Avondale	1,150	A
SR 96 east of North Avondale	1,500	A
SR 96 west of Boone	1,700	A
North Avondale Blvd.	190[b]	A

[a]Estimated by Argonne National Laboratory.

[b]Smith 2000.
Source: Tinney 2000.

The combination of direct and indirect employment and direct and indirect income would generate population growth in Pueblo County, as workers (some with families) would in-migrate to fill direct and indirect jobs. This population growth would be the primary impacting factor for housing, schools, and public services. The increased sales of goods and services that would accompany this population growth would generate additional public revenues.

The extent to which these impacting factors would affect Pueblo County, and the significance of those effects, is discussed for construction and operation of the various destruction options in Sects. 4.21.3 and 4.21.4. Where possible, the levels of impact significance discussed below are based on Rational Threshold Values (RTVs) of impact significance that have been developed as part of the Army Environmental Policy Institute's *Economic Impacts Forecast System* (EIFS). These RTVs establish county-specific thresholds for various socioeconomic indicators at which significant impacts can be expected. Using EIFS for Pueblo County, RTVs have been established for increases in population (1.82%), employment (4.37%), and income (5.3%) (AEPI 2000).

4.20.3 Impacts of Construction

4.20.3.1 Impacts of baseline incineration

Population. The impact of constructing baseline incineration facilities would be relatively small in terms of population growth in Pueblo County. Assuming direct employment of 550 during the peak construction period, and assuming a direct-to-indirect employment ratio of 0.781 (ANL 2001a), indirect employment could total as many as 430 jobs. Given this total number of direct and indirect jobs (980), and assuming a jobs-to-in-migration ratio of 0.596 (ANL 2001a), an estimated 584 people could in-migrate to Pueblo County during the peak construction period

(Table 4.37). This in-migration would represent only 0.4% of Pueblo County's 2001 population, well below the RTV of 1.82%.

Employment. The impact of constructing baseline incineration facilities would be more significant for local employment than for population growth. It is estimated that the peak construction period would require a work force of 550. Assuming the factors discussed above, indirect employment could total as many as 430 jobs, for a total of 980 new jobs in Pueblo County (Table 4.37). It is likely that some of these new jobs could be filled by residents of Pueblo County, because 980 jobs represents only 2.2% of Pueblo County's 1997 labor force and the county's unemployment rate is higher than the state's (Sect. 4.21.1). A 2.2% increase in employment would be well below the RTV of 4.37%.

Income. Using the 980 direct and indirect jobs estimated above, and using an average wage for direct and indirect jobs of $31,325 (ANL 2001a), total personal income of over $30.7 million could be created during the peak construction year (Table 4.37). This would represent only 1.3% of total personal income in Pueblo County is 1997 (Sect. 4.21.1), well below the RTV of 5.3%.

Housing. With the possibility of 584 people in-migrating, and assuming an average household size of 2.8 persons per household, demand for housing associated with the peak construction period could be around 209 units. This demand would represent about 5.6% of the available housing units in Pueblo County in 2000 (Sect. 4.21.1). The PDADA has expressed concern that this increase in demand could result in increased prices and even housing shortages in the low-income market (PDADA 2001). However, it is expected that the demand for housing associated with construction would be so small and short-lived that it would not have significant impacts on the housing market.

Schools. Because in-migration associated with the peak period of baseline facility construction would be relatively small (only about 0.4% of Pueblo County's 2001 population), it is not likely that the number of school-aged children who would in-migrate with their parents would have a significant impact on school enrollment in School Districts 60 and 70. Pueblo County has stated that the children of employees relocating in the county "should be easily accommodated within the school systems in Pueblo" (Pueblo County 1999).

Public Services. Neither baseline facility construction nor the in-migration it would generate would have significant impacts on off-post infrastructure or public services. Increased demand for water directly related to construction would not be significant (Sect. 4.3.3), nor would increased demand due to population growth of 0.4%. Construction would not directly affect the provision of sewer services in Pueblo County because on-post wastewater would be treated using a package treatment system with effluent going to lagoons. The increased demand for sewer services of a 0.4% population increase would be insignificant.

Similarly, construction would not directly affect the provision of electricity or natural gas in Pueblo County (Sects. 4.4.2 and 4.5.3), and the increased demand for electricity and natural gas associated with in-migration would be insignificant. The potential direct and indirect impacts to other public services, such as police and fire protection and hospitals, likewise would be negligible (Pueblo County 1999a).

Table 4.37. The effects of constructing and operating facilities for chemical agent destruction on selected socioeconomic resources in Pueblo County

	Baseline incineration		Modified incineration		Neutralization/SCWO		Neutralization/Biotreatment	
	Construction[a]	Operation[b]	Construction	Operation	Construction	Operation	Construction	Operation
Employment[c]								
Direct	550	600	413	504	950	635	830	635
Indirect	430	383	323	322	537	536	498	536
Total	980	983	736	826	1487	1171	1328	1171
Population in-migration	584	508	439	427	1153	754	1013	754
Direct income ($ millions)	30.7	29.6	23.1	24.9	35.4	30.2	33	30.2

[a]Impacts are shown for peak construction year.
[b]Impacts are shown for first year of operations.
[c]Includes employment related to chemical agent destruction, not existing employment at the PCD.
Source: U.S. Army 2000b; ANL 2001b.

Public Finances. Construction of the baseline facilities would result in increased revenues for local governments, primarily Pueblo County and the City of Pueblo. Most of these increased revenues would come from state and local sales taxes associated with employee spending during construction. For example, Pueblo County estimates that the additional revenues it would receive from indirect business taxes as a result of chemical demilitarization facility construction would average $7.7 million annually (Pueblo County 1999a). It is expected that revenues of this magnitude would more than offset the cost of providing any additional public services required due to facility construction.

Transportation and Traffic. Pueblo County is very concerned about the effects of construction on traffic flow and safety on U.S. Highway 50 (Pueblo County 1999a). Vehicles access PCD from the south via a grade-separated interchange from U.S. 50. This interchangecould pose safety concerns due to the increased traffic that would result from facility construction. The existing interchange has two lanes but no shoulder, and steep curves immediately off the eastbound exit are hazardous. In addition, the entrances to U.S. 50 from the interchange lack acceleration lanes and are extremely dangerous for entering traffic as well as through traffic on U.S. 50. Pueblo County recommends that the Army mitigate these potential impacts to traffic flow and safety by re-designing and re-constructing the interchange to provide shoulders and allow safer egress and exit (Pueblo County 1999a).

Agriculture. Constructing baseline facilities would have no impacts on agriculture in Pueblo County because all construction activities would be confined to PCD.

4.20.3.2 Impacts of modified incineration

The impacts of constructing modified incineration facilities would be somewhat less than those of constructing baseline facilities due to the presence of fewer direct employees (413) during the peak construction period (U.S. Army 2000b). Using the assumptions described in Sect. 4.20.3.1, indirect employment could total as many as 323 jobs, direct and indirect employment combined could total 736 jobs (1.6% of the county’s 1997 labor force, compared to an RTV of 4.37%), and estimated in-migration could total 439 people during the peak construction period (Table 4.37). This in-migration would represent about 0.3% of Pueblo County’s 2001 population, well below the RTV of 1.82%.

Based on the estimate of 736 direct and indirect jobs, total personal income of over $23.1 million could be created during the peak construction year (Table 4.37), which would represent less than 1.0% of total personal income in Pueblo County in 1997 (Sect. 4.20.1). A 1.0% increase in income would be well below the RTV of 5.3%. Demand for housing associated with the peak construction period could be around 157 units, which would represent about 4.2% of the available housing units in Pueblo County in 2000 (Sect. 4.20.1). The PDADA has expressed concern that this increase in demand could result in increased prices and even housing shortages in the low-income market (PDADA 2001). However, it is expected that the demand for housing associated with construction would be so small and short-lived that it would not have significant impacts on the housing market. Impacts to public services and agriculture would be similar to those described for baseline incineration.

4.20.3.3 Impacts of neutralization alternatives

Population. The potential socioeconomic impacts of constructing a pilot facility for neutralization with SCWO or biotreatment would be relatively small because in-migration would not be significant (ANL 2001a). In terms of population growth, an estimated 1,013-1,153 persons would in-migrate to Pueblo County during the peak construction year. Although this population increase would be larger than that projected for the incineration options (Table 4.37), it would be below the RTV of 1.82%.

Employment. Constructing facilities for neutralization with SCWO would create 950 direct jobs and 537 indirect jobs during the peak period (ANL 2001b). Neutralization with biotreatment would create 830 direct jobs and 498 indirect jobs during the peak construction period (ANL 2001b). Although these increases in employment would be larger than those projected for the incineration options (Table 4.37), they would be below the RTV of 4.37%.

Income. Constructing facilities for neutralization with SCWO would generate $35.4 million in direct income during the peak period; neutralization with biotreatment would generate $33.0 million during the peak period (ANL 2001a). Although these increases in income would be larger than those projected for the incineration options (Table 4.37), they would be below the RTV of 5.3%.

Housing. In-migration due to SCWO construction would require about 480 housing units in Pueblo County; in-migration due to biotreatment construction would require about 450 units (ANL 2001a). This would represent about 12-13% of the available housing units in Pueblo County in 2000 (Sect. 4.20.1). The PDADA has expressed concern that this increase in demand could result in increased prices and even housing shortages in the low-income market (PDADA 2001). However, it is expected that the demand for housing associated with construction would be so small and short-lived that it would not have significant impacts on the housing market.

Schools. No significant impact on schools would occur during the construction of either SCWO or biotreatment facilities because in-migration would be relatively small (ANL 2001a).

Public Services. No significant impact on public services would occur during the construction of either SCWO or biotreatment facilities because in-migration would be relatively small (ANL 2001a).

Public Finances. The construction of either type of neutralization facility would result in substantial increased revenues for local governments and school districts (ANL 2001a).

Transportation and Traffic. Employee commuting during construction would have a similar impact to that discussed for baseline incineration (see Sect. 4.20.3.1) (ANL 2001a).

Agriculture. Constructing facilities for neutralization with SCWO or biotreatment would have no impacts on agriculture in Pueblo County because all construction activities would be confined to PCD (ANL 2001a).

4.20.4 Impacts of Operation

4.20.4.1 Impacts of baseline incineration

Population. The impact of operating baseline incineration facilities would be relatively small in terms of population growth in Pueblo County. Assuming direct employment of 600 during operations, and assuming a direct-to-indirect employment ratio of 0.639 (ANL 2001a), indirect employment could total as many as 383 jobs. Given this total number of direct and indirect jobs (983), and assuming a jobs-to-in-migration ratio of 0.517 (ANL 2001a), an estimated 508 people could in-migrate to Pueblo County (Table 4.37). This in-migration would represent less than 0.4% of Pueblo County's 2001 population, well below the RTV of 1.28%.

Employment. The impacts of operating baseline incineration facilities would be more significant for local employment than for population growth. Using the estimates discussed above, a total of 983 new jobs would be created in Pueblo County (Table 4.37). Some of these new jobs could be filled by residents of Pueblo County because 983 jobs represents only 2.2% of Pueblo County's 1997 labor force and the county's unemployment rate is higher than the state's (Sect. 4.20.1). A 2.2% increase in employment would be well below the RTV of 4.37%.

Income. Assuming that baseline facility operations would create a total of 983 direct and indirect jobs, and using an average wage for direct and indirect jobs of $30,100 (ANL 2001a), total personal income of over $29.6 million could be created each year (Table 4.37). This would represent only 1.2% of total personal income in Pueblo County is 1997 (Sect. 4.20.1), well below the RTV of 5.3%.

Housing. With the possibility of 508 people in-migrating, and assuming an average household size of 2.8 persons per household, demand for housing associated with baseline operations could be around 181 units. This demand would represent about 4.9% of the available housing units in Pueblo County in 2000 (Sect. 4.20.1). The PDADA has expressed concern that this increase in demand could result in increased prices and even housing shortages in the low-income market (PDADA 2001). However, it is expected that the demand for housing associated with construction would be so small and short-lived that it would not have significant impacts on the housing market.

Schools. Because in-migration associated with baseline operations would be relatively small (only about 0.4% of Pueblo County's 1998 population), it is not likely that the number of school-aged children who would in-migrate with their parents would have a significant impact on school enrollment in School Districts 60 and 70.

Public Services. Baseline facility operations would have larger direct effects on off-post infrastructure and public services than construction. However, the indirect effects of in-migration associated with operations would be negligible.

The increase in local water demand directly related to baseline facility operations would be substantial but would not affect off-post uses (Sect. 4.3.3). The increased demand for water due to 0.4% population growth associated with operations would not have significant impacts on the supply or price of water locally.

Operations would not directly affect the provision of sewer services in Pueblo County because on-post wastewater would be treated using a package treatment system with effluent going to lagoons. The increased demand for sewer services of a 0.4% population increase would be insignificant.

Similarly, operations would not directly affect the provision of electricity or natural gas in Pueblo County (Sects. 4.4.2 and 4.5.3), and the increased demand for electricity and natural gas associated with in-migration would be insignificant. The potential direct and indirect impacts to other public services, such as police and fire protection and hospitals, likewise would be negligible (Pueblo County 1999a).

Public Finances. Operation of the baseline facilities would result in increased revenues for local governments, primarily Pueblo County and the City of Pueblo. Most of these increased revenues would come from state and local sales taxes associated with employee spending during operations. For example, Pueblo County estimates that the additional revenues it would receive from indirect business taxes as a result of chemical demilitarization facility operation would average almost $9.5 million annually (Pueblo County 1999a). It is expected that revenues of this magnitude would more than offset the cost of providing any additional public services required due to facility operation.

Transportation and Traffic. The operation of baseline facilities would result in impacts to traffic on U.S. Highway 50 similar to those discussed for construction in Sect. 4.20.3.1.

Agriculture. Routine operation of baseline facilities would have no impacts on agriculture in Pueblo County because all operational activities would be confined to PCD.

4.20.4.2 Impacts of modified incineration

Population. The impacts of operating modified incineration facilities would be somewhat less than those of operating baseline facilities due to the presence of fewer direct employees (504) (U.S. Army 2000b). Using the assumptions described in Sect. 4.20.4.1, indirect employment could total 322 jobs, for total direct and indirect employment of 826 (2.4% of the county's 1997 labor force, compared to an RTV of 4.37%). Estimated in-migration could total 427 persons during modified facility operations (Table 4.37). This increase would represent between 0.3% and 0.4% of Pueblo County's 2001 population, well below the RTV of 1.28%.

Based on the 826 direct and indirect jobs estimated above, total personal income of between \$24.9 million and \$32.3 million could be created each year (Table 4.37). This would represent between 1.0% and 1.3% of total personal income in Pueblo County is 1997 (Sect. 4.20.1), well below the RTV of 5.3%.

Demand for housing associated with modified incinerator operations could total 153 units, which would represent about 4.1% of the available housing units in Pueblo County in 2000 (Sect. 4.20.1). The PDADA has expressed concern that this increase in demand could result in increased prices and even housing shortages in the low-income market (PDADA 2001). However, it is expected that the demand for housing associated with operations would be so small and short-lived that it would not have significant impacts on the housing market. Impacts to public services and agriculture would be similar to those described for baseline incineration.

4.20.4.3 Impacts of neutralization alternatives

Population. The socioeconomic impacts of operating a pilot facility for neutralization with SCWO or biotreatment would be relatively small because in-migration would not be significant. In terms of population growth, an estimated 754 persons would in-migrate to Pueblo County as a result of destruction operations. Although this population increase would be larger than that projected for the incineration options (Table 4.37), it would be below the RTV of 1.28%

Employment. Operating facilities for neutralization with either SCWO or biotreatment would create 635 direct jobs and 536 indirect jobs. Although these increases in employment would be larger than those projected for the incineration options (Table 4.37), they would be below the RTV of 4.73%.

Income. Operation of a SCWO pilot facility would produce about \$30.2 million annually in direct income. Operation of a biotreatment facility would also produce about \$30.2 million annually. Although these increases in income would be larger than those projected for the incineration options (Table 4.37), they would be below the RTV of 5.3%

Housing. In-migration associated with the operation of SCWO or biotreatment facilities would require about 280 housing units in Pueblo County. This would represent about 7.5% of the available housing units in Pueblo County in 2000 (Sect. 4.20.1). The PDADA has expressed concern that this increase in demand could result in increased prices and even housing shortages in the low-income market (PDADA 2001). However, it is expected that the demand for housing associated with operations would be so small and short-lived that it would not have significant impacts on the housing market.

Schools. No significant impact on schools would occur during operations at either SCWO or biotreatment facilities because in-migration would be relatively small.

Public Services. No significant impact on public services would occur during operations at either SCWO or biotreatment facilities because in-migration would be relatively small.

Public Finances. The operation of either type of neutralization facility would result in substantial increased revenues for local governments and school districts.

Transportation and Traffic. Employee commuting during operations would have a similar impact to that discussed for incineration (see Sect. 4.20.3.1).

Agriculture. Routine operation of facilities for neutralization with SCWO or biotreatment would have no impacts on agriculture in Pueblo County because all operational activities would be confined to PCD.

4.20.5 Impacts of No Action

Under the no action alternative, the socioeconomic impacts of current activities at PCD would continue. Excluding contractors, military personnel, and reuse tenants, PCD directly employs approximately 150 people. As a result of PCD employee expenditures for goods and services, there are an estimated 120 indirect jobs in the local economy. On-post employment and related expenditures also create an estimated $11 million annually in personal income in the local economy.

Without destruction facility construction and operations, there would be none of the socioeconomic impacts discussed in Sects. 4.21.3 and 4.21.4, particularly the potential impacts to public services and traffic. Conversely, there would be none of the beneficial effects related to employment, income, and public finances.

4.20.6 Cumulative Impacts

Construction and operation of the proposed chemical destruction facilities could combine with other past, present, and future actions to create cumulative socioeconomic impacts in Pueblo County. The most obvious on-post action that would also contribute to socioeconomic impacts is the ongoing effort to find new uses for PCD facilities under the *Reuse Development Plan Update* (PDADA 2000a). These uses would combine with the proposed destruction facilities to produce both adverse impacts (increased demand for water and other utilities and increased traffic on U.S. Highway 50) and beneficial effects (increased employment, income, and public revenues).

Off-post activities such as agriculture, residential development, and industrial and commercial development around PCD and elsewhere in Pueblo County would also contribute to these impacts. The resource most likely to be adversely affected by these cumulative impacts is water, the local supply of which is extremely sensitive to increased demand.

4.21 ENVIRONMENTAL JUSTICE

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," 59 FR 7629 (Feb. 11, 1994), directs all agencies to consider environmental justice so that an agency’s actions will not have "disproportionately high and adverse human health or environmental effects on minority and low income populations." The Order established an Interagency Working Group (IWG) chaired by EPA and comprised of the heads of eleven departments/agencies and several White House offices. In addition to the EPA, these include the Departments of Justice, Defense, Energy, labor, Interior, Transportation, Agriculture, Housing and Urban Development, Commerce, and Health and Human Services, the Council on Environmental Quality, the Office of Management and Budget, the Office of Science and Technology Policy, the Domestic Policy Council, and the Council of Economic Advisors.

Under the omnibus authority provided to EPA through the Resource Conservation and Recovery Act [RCRA, Sections 3004 (u), 3004 (v), and 3008(h)], EPA may consider factors such as "cumulative risk, unique exposure pathways, or sensitive populations in establishing permitting or clean-up priorities." Data (including maps) aggregated from the census block level from the 1990 U.S. Census and the national EPA ENVIROFACTS database are available from EPA Region 8 office of Enforcement, Compliance, and Environmental Justice Program (personal communication, Nancy Reish, EPA Region 8, to Barbara Vogt, ORNL, July 11, 2001). The data includes demographic information , poverty status, and the number of facilities reporting emissions or considered for or in the process of clean-up of hazardous waste sites in the vicinity. EPA also provides small grants and training to ensure that all communities and affected stakeholders are able to participate in the decision-making process (MOU 2001).

The Army has complied with the executive order to identify minority and low-income groups and has worked to provide the communities with information on the chemical demilitarization efforts and emergency preparedness if an accident occurs at the Depot through an staffed outreach office in the City of Pueblo.

The data incorporated into this section uses the 2000 Census data for examining the impacts on minority populations. However, 2000 Census data on low-income populations will not be released until 2002, thus requiring use of other Census model estimated data for analysis. The Army is committed to using the best and most credible information available, including the use of the 2000 Census data whenever possible.

4.21.1 Existing Conditions

4.21.1.1 Minority populations

The Bureau of Census provides the basis for identifying racial groups. Though similar to the 1990 five categories for racial classification, the 2000 Census used seven categories: White, Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, Some other race, and Two or more races. Distribution of the last category into minority or non-minority status has not been defined. The 1990 Census use five basic racial categories: American Indian or Alaska Native, Asian or Pacific Islander, Black, White, and an "Other race" category that allows respondents a write-in entry. The concept of race reflects the self-identification by respondents and is not intended to reflect any biological or anthropological definition. Persons of Hispanic origin are identified as an ethnic group and may be of any race.

Information on the demographic an characteristics for the counties within a 31-mi radius was first collected and summarized (Table 4.38). The 31-mi radius of the circle defining the area of interest was selected to coordinate with the assessment of impacts to human health and safety. The area include parts of Crowley, El Paso, Huerfano, Las Animas, Lincoln, and Otero Counties, and all of Pueblo County. To identify areas with disproportionate representation of minority populations, the state of Colorado as a whole was used as a reference point for proportions of minority populations. Of the state of Colorado residents recorded by the 2000, 17% categorized themselves as one of the minority groups discussed above (including the two or more race

Table 4.38. Percentage (%) minority groups in counties and urban areas within 31 miles of the proposed destruction facility at the Pueblo Chemical Depot

Place	Total population (2000)	White[a]	Black or African American[a]	American Indian and Alasak Native[a]	Asian	Native Hawaiian and other Pacific Islander[a]	Some other race[a]	Two or more races[a]	Hispanic or Latino (or any race)[b]	White, not of Hispanic or Latino Origin
Crowley County	5518	82.9	7	2.6	0.8	2	4.8	1.8	22.5	66.5
El Paso County	516929	81.2	6.5	0.9	2.5	0.2	4.7	3.9	11.3	76.2
Huerfano County	7862	81	2.7	2.7	0.4	0.1	9.4	3.7	35.1	58.5
Las Animas County	15207	82.6	0.4	2.5	0.4	0.2	10	3.8	41.5	55.2
Lincoln County	6087	86.3	5	0.9	0.6	2	5.7	1.6	8.5	84.2
Otero County	20311	79	0.8	1.4	0.7	0.1	15.1	3	37.6	59.2
Pueblo County	141472	79.5	1.9	1.6	0.7	0.1	12.9	3.4	38	57.7
City of Pueblo	102121	76.2	2.4	1.7	0.7	0.1	15.2	3.7	44.1	51.1
State of Colorado	4301261	82.8	3.8	1	2.2	0.1	7.2	2.8	17.1	74.5

[a]Indicates persons reporting only one race.
[b]Hispanic/Lations may be of any race, so also are included in applicable race categories.
Source: U.S. Census Bureau, Census 2000 Redistructing Data (Public law 94-171) Summary file, Matrices PL1, PL2, PL3, and PL4. April 2001.

category) and 17.1 classified themselves as Hispanic or Latino (of any race). Table 4.38 indicates that of the seven counties examined, only two (El Paso and Lincoln) have lower than average numbers of Hispanic or Latino (of any race) than the state as a whole. Pueblo County has more than twice (38.0%) the state's average (17.1%) of Hispanic or Latino (of any race) residents. The City of Pueblo has even a greater percentage (44.1%).

Minority groups were also examined for proximity to the project site and compared to other groups within Pueblo the county's population. Using a geographic information system program that links census block data with spatial characteristics, summations were generated by geographical areas within a 10-km and 20-km (6-mile and 12-mile) radius from the proposed location of the destruction facility at PCD. Using the 10-km and 20-km radii (supported by data available at the census block level) provides a more definitive analysis of populations within the immediate vicinity of PCD. Table 4.39 displays the population figures for subgroups residing near the depot.

Table 4.39. Proportions of populations within 6 miles and 12 miles of the Pueblo Chemical Depot

	Population within 10 km		Population within 15 km	
	No.	%	No.	%
Total	79	100	1831	100
White	62	78.5	1617	88.3
Black or African American	2	2.5	6	0.3
American Indian and Alaskan Native	0	0	40	2.2
Asian	0	0	7	0.4
Native Hawaiian and other Pacific Islander	1	1.3	2	0.1
Some other race	8	10.1	100	5.5
Two or more races	6	7.6	25	1.4
Hispanic or Latino (of any race)[a]	16	20.3	763	41.7

[a]Persons of Hispanic origin may be of any race; numbers for Hispanics/Latinos are therefore included in the totals for the other categories in this table.

Source: U.S. Census Bureau, 2000 Census of Population and Housing.

The Hispanic population (of any race) in Pueblo County continued to grow between 1990 and 2000. The Hispanic component represented approximately 38.0% of the Pueblo County's population and 44% of Pueblo City's population. Accordingly, largely Hispanic populations are located within a 10-km (6-mile) radius of the proposed destruction facility at PCD. The proportions of minority subgroups (see Table 4.39) indicate that within the 10-km radius, approximately 20.3% of the population is Hispanic or Latino origin and within the 15-km the percentage is 41.7%. However, this figure likely does not account for the transient agricultural Hispanic or Latino workers or seasonal laborers who may not have been counted in the 2000 Census. Efforts by the Army in conjunction with a number of other state and federal agencies to examine the numbers of such workers and/or their approximate locations to PCD were futile and have not lead to any valid estimates at this time. Therefore the percentage of Hispanic/Latino sub-groups may be higher in the immediate vicinity of PCD than reported by the census data.

Fig. 4.16 describes the proportions of Census blocks with percentages of Hispanic and Latino populations within the 50 km radius of the proposed facility. Of the total number of blocks with the 50 km radius reporting some percentage of Hispanic and Latino (of any race) 1,966 blocks had from 25 to 100 percent of such residents.

In 1990, approximately 17.4% of Pueblo County's population spoke a language other than English at home. This assumes that the other predominant language is Spanish, based on the large Hispanic/Latino population present in the county. That percentage was higher than the average for the state of Colorado (10.5%), for Crowley County (14.5%), and for El Paso County (9.0%), but lower than for Otero County (21.3%). Reflective of this fact, Pueblo County has had materials regarding off-site emergency response to an accidental chemical agent release printed in both Spanish and English.

4.21.1.2 Low-income populations

Individuals who fall below the poverty line are classified as being in a low-income group. Calculations for determining those below poverty level will vary by year. Since information on poverty from the 2000 Census will not be released until 2002, the documentation on poverty levels rely on 1997 model based estimates derived from various sources by Census data collectors. For the 1990 census, the poverty line was defined by a statistical threshold based on a weighted average that considered both family size and the ages of individuals in a family. For example, the 1990 weighted-average poverty-threshold annual income for a family of five was $14,990, while the poverty-threshold income for a family of five with three children less than 18 years old was $14,796 (U.S. Bureau of the Census 1992a). If a family fell below the poverty line for its particular composition, the census considered all individuals in that family to be below the poverty line.

The percentage of individuals living below the poverty level was examined for Pueblo County and compared to other counties within 31 miles of PCD. Table 4.40 displays the status in 1997. The figures indicate that slightly less than one in five persons (18.1% of the population) had incomes below the poverty level in 1997. The figure for 1990 was slightly higher at 20.1%. All counties in the 50-km area except El Paso had incomes below the poverty level at that time. This compares to 10.2% for the state of Colorado for individuals.

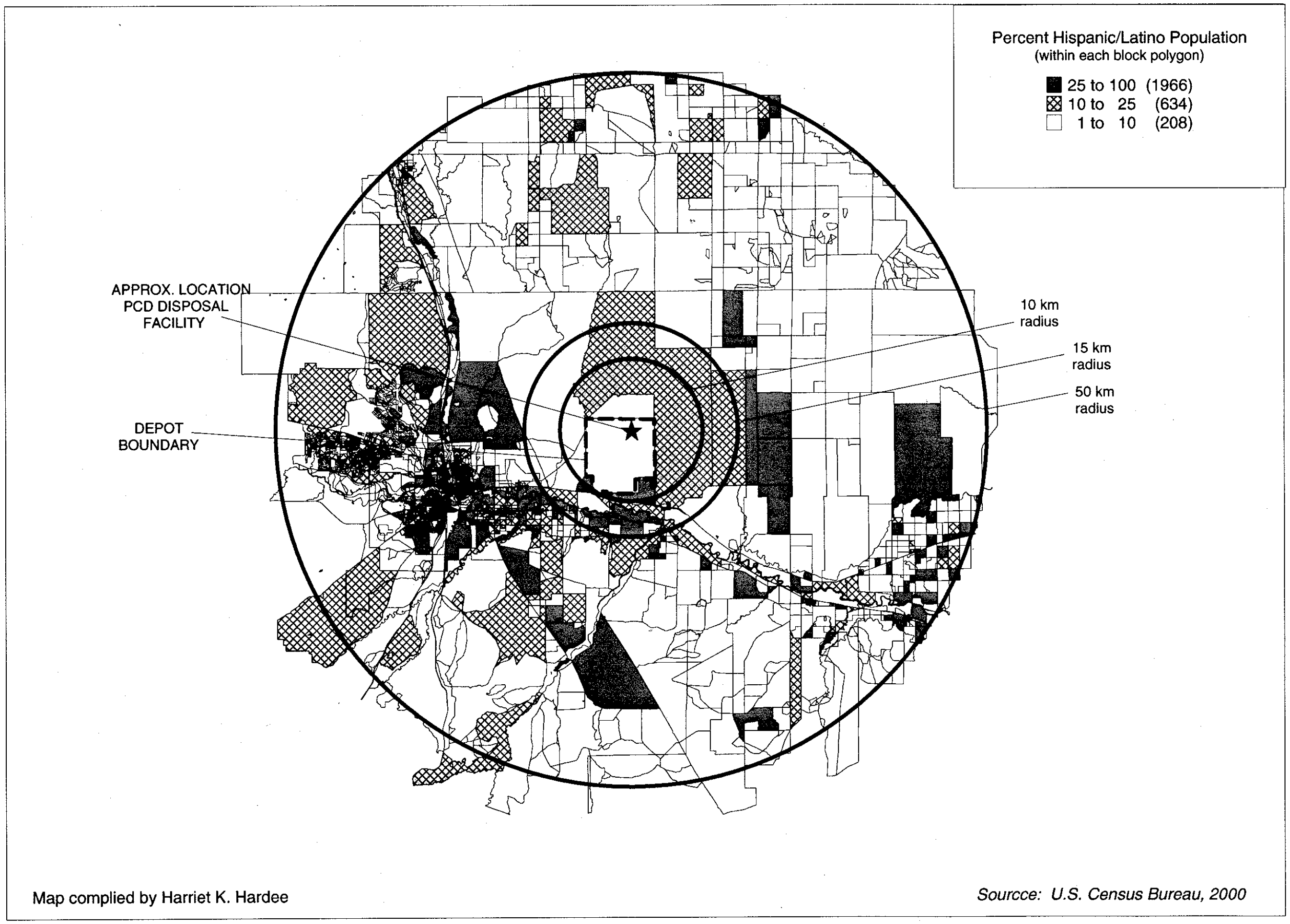


Fig. 4.16. Proportion of Census blocks with 1-10, 10-25, and 25-100 percent Hispanic or Latino (of any race).

Table 4.40. Income and poverty status in counties within 31 miles of the Pueblo Chemical Depot

Place	Number of households in 2000	Median household income, 1997 model-based estimate ($)	Households with persons under 18 years, 2000 (%)	Persons below poverty, 1997 model-based estimate (%)	Children below poverty, 1997 model-based estimate (%)
Crowley County	1358	23524	37.3	32.2	40
El Paso County	192409	42023	39.3	9.5	14.6
Huerfano County	3082	21389	27.7	23.4	34.3
Las Animas County	6173	22682	32.2	18.1	25.8
Otero County	7902	25143	35.4	22.8	32.1
Pueblo County	54579	29112	35.2	18.1	25.8
State of Colorado	1658238	40863	35.3	10.2	14.6

Source: U.S. Census Bureau, Sate and county Quickfacts. Data developed from Population Estimates, 2000 Census of Population and Housing. 1990 Census of Population and Housing, Small area Income and Poverty Estimates, County Business patters, 1997, Economic Census, minority- and Women-Owned Business, Building Permits, Consolidated Federal Funds Report, 1997 Census of Governments (http://quickfacts.census.gov/).

During that same timeframe none of the counties in this study except El Paso had median incomes equal to the state of Colorado's average figures. While Colorado residents had an overall median family income of $40,863 and a per capita income of $14,821, Pueblo County residents averaged slightly more than $10,000 below the state value for a median household income of $29,112. These values indicate that Pueblo County has a higher than average percentage of low-income population subgroups.

In addition, projections of the age structure in Pueblo County indicate the number of elderly persons within Pueblo County are increasing. As many elderly persons rely on fixed incomes, this trend may contribute to higher proportions of low-income sub-groups within Pueblo County. Other groups that may be more vulnerable for environmental justice considerations include the very young, the mobility or physically impaired, and single female headed households.

4.21.2 Destruction Impacting Factors

Activities associated with chemical munitions destruction will not affect significantly or disproportionately existing populations of minority or low-income residents in the vicinity of PCD. Although the number of minority groups are larger nearer the PCD than on average for the rest of Colorado, emissions or other off-post discharges are not expected to occur under normal operating conditions. In addition the facility would be monitored continuously to ensure that any emissions remain below permitted levels and standards or the facility would be temporarily shut down as has occurred at Tooele, Utah. Thus, there will not be any adverse human health or environmental effects on minority and low income populations unless an accidental chemical agent release occurs (see Sect. 4.2.2.5). The environmental justice assessment for destruction of chemical munitions is not affected by the decision concerning the implementation of incineration or neutralization alternatives.

Non-quantitative health care costs borne by highly susceptible minority and low-income population sub-groups may not be included in the overall final cost analysis. Such analysis is not possible at this time because the numbers and existing health care issues are not available and are largely anecdotal. Any PCD agent disposal facility will be of such visibility that a high level of regulatory oversight is ensured. Cancer risks at levels discussed in Sect. 4.9 are expected to be exceedingly low (10^{-5} for lifetime) and will therefore not contribute significantly to the health burden. To interpret 10^{-5}, if 100,000 people were exposed for 40 years as subsistence farmers who lived at the location of highest impact and grew all their foods there, one person might contract a fatal cancer. This is contrasted with approximately 25,000 cancer deaths anticipated due to natural causes.

4.21.3 Impacts of Construction

The construction of a chemical munitions destruction facility would be carried out in compliance with accepted environmental and occupational standards for such activities. Therefore, they would not cause adverse human health or environmental effects to minority and low income populations. It is expected that the construction activities could provide additional income to the population sub-groups who could provide services to the in-migrant workers and their families who would be employed directly in the construction phase.

4.21.4 Impacts of Operations

Activities associated with destruction facility operations would be carried out in compliance with permitted emission levels, and would be continuously monitored to ensure compliance. Therefore, destruction facility operations would not cause adverse human health or environmental effects to minority and low income populations. Health effects of routine operations are addressed in depth in Sect. 4.9. There is no evidence to suggest that operations would affect minority or low-income populations differently than the population as a whole.

4.21.5 No Action Alternative

Activities during continued storage include all current storage and maintenance operations. These operations are defined as those which occur without any accidental release of chemical agent into the environment. Analysis of this alternative assumes that "business as usual" would occur during continued storage activities and will not create disproportionately high and adverse human health or environmental effects on minority and low income populations. No impacts would occur from inaction to any population.

4.21.6 Cumulative Impacts

Destruction facility operations would be carried out in compliance with health and environmental standards and permitted emissions levels. Facility operations would be monitored continuously to ensure compliance. Because of the continuous monitoring and the fail-safe mechanisms built into the facility, the possibility for an accidental release to the environment is very remote. Therefore, no cumulative impacts are expected to result in adverse human health or environmental effects to minority and low income populations.

4.22 IMPACTS OF ACCIDENTS

Measures would be employed to reduce the potential for an accident during the operation of a chemical munitions destruction facility at PCD, regardless of whether incineration or neutralization technologies were selected for construction. Additional measures would be in place to contain any contamination in the unlikely event that an accident involving agent should occur, and to clean up contaminated facilities and resources in the even more remote possibility that an accident should result in external contamination. Measures to avoid a potential accident include: (1) intensive training of personnel in monitoring and assessing facility conditions, and in using proper operational and contingency procedures; and (2) design of the facility to include many monitoring and fail-safe features to automatically shut down operations should abnormal conditions arise. In the event that an accident should occur during operations, redundant containment features (e.g., multiple containment barriers and negative air pressure HVAC) would be designed into the facility to reduce the likelihood that agent could escape into the environment. Finally, if a release of agent were to occur, which involved a spill or down-wind deposition of agent, the Army would have in place procedures, equipment, and trained personnel for addressing the situation quickly in order to contain contamination and clean up affected areas.

The above measures would control and contain within the facility virtually all the foreseeable, accident scenarios associated with destruction operations at PCD. Thus, the probability that any accident which might involve off-post release of mustard agent is extremely low (see Appendix H). However, the impacts of such an unlikely worst-case event involving an aircraft crash or a severe earthquake followed by a fire could be very serious.

This section provides information concerning the potential impacts to surrounding environmental resources and human health if an accident involving release of agent were to occur. The analysis of hazards and accident scenarios in this EIS is solely intended to provide estimates of the extent of the zone of potential impact from hypothetical accidents at PCD. As such, the accident analysis presented in this EIS should not be considered to be a detailed safety assessment. As discussed in Appendix H, a worst-case bounding accident is used in this section to describe the potential impacts that could create lethal airborne concentrations of agent HD at distances up to 19 miles (30 km) from the accident. This accident would be associated with the continued storage of the munitions at PCD and would involve an aircrash into a storage igloo. Accidents during destruction operations would be smaller events (because of the smaller inventory of agent inside the MDB as compared to the inventory inside a storage igloo), as described in detail in Appendix H of this EIS; however, these non-storage accidents are not used in the assessment of potential impacts in this EIS. Instead, the impacts of the 19-mile (30-km) bounding accident are described in the following sections.

4.22.1 Land Use

Spills. Accidents associated with the proposed action (i.e., munition destruction activities) could involve a spill of mustard agent onto the land surface at the existing storage area, along the on-site transportation route, or at the site of the destruction facility. Spills, in turn, could result in a release of mustard agent into the atmosphere by evaporation. An accidental spill of agent would likely be limited to a small area of land in the vicinity of the accident, but could result in a high level of contamination of soils in the immediate vicinity of the spill. As a result of such a spill, only a small area of land would be affected.

Because only a small area contained within the site would be affected, and because of rapid response and decontamination at the spill site in accordance with an approved spill prevention, control, and countermeasures plan, off-site environmental impacts to land use would be small, except possibly during periods of heavy precipitation or snowmelt following an accidental spill. Rapid response and decontamination also would minimize runoff and seepage of any mustard agent that was spilled. Larger areas could be impacted if heavy precipitation or snowmelt mobilized the spilled agent prior to its cleanup. The bleach solution typically used in the decontamination process could adversely impact vegetation in the immediate vicinity of the spill.

Deposition of Airborne Agent. An accidental release of mustard agent into the atmosphere could affect a larger area of PCD than would a spill. Such an accident would have significant impacts to on-post land use, as the contamination of on-post buildings and facilities would preclude (at least temporarily) all use of the installation as proposed in the *Reuse Development Plan Update* (PDADA 2000a).

Off-post land area downwind from PCD could also be affected. The size of the area would depend on the size of the release and meteorological conditions at the time (see Appendix H). Grazing of livestock off-post and downwind from PCD would be precluded until the contamination declined to levels at which animals could safely graze. The use of land for growing crops within contaminated areas and the consumption of crops produced also would be temporarily discontinued. Agricultural crops contaminated with chemical agent resulting from direct deposition would not be suitable for human or animal consumption.

The length of time during which grazing and crop growing would be precluded following an atmospheric release depends on the amount of agent deposited and persistence of the mustard agent. Land contaminated following an atmospheric release of mustard agent may be unavailable for grazing or crops for weeks to months, although contaminated crops might be unsuitable for harvest for as much as a year.

4.22.2 Utilities

The accidental release of mustard agent, whether through a direct spill or emissions to the atmosphere, could affect on-post and off-post availability of water, electricity, and natural gas by diverting the available capacities from routine uses (including chemical agent destruction) to emergency response activities.

4.22.3 Waste Management

An undeterminable amount of contaminated wastes could be produced by clean-up activities following and accidental spill of mustard agent or an accident involving dispersion of agent. Spill and emergency response plans and resources would be in place to contain, clean-up, decontaminate, and dispose of wastes according to existing standards and regulations. See also the discussion of contaminated soils in Sect. 4.22.6 of this EIS.

4.22.4 Air Quality

Relatively short-term, but very significant, effects to air quality could occur as a result of an accidental release of mustard agent to the atmosphere. A large atmospheric release, such as might occur during the 19-mile (30 km) bounding accident, could have serious environmental and human health impacts. These impacts are addressed in the following sections of this EIS (see, for example, the discussion of human health impacts in Sect. 4.22.5 and impacts to ecological resources in Sects. 4.22.9 to 4.22.11. Appendix H, the transport and dispersion of hypothetical atmospheric plumes of mustard agent are evaluated by modeling the accidental release of agent under different meteorological conditions.

4.22.5 Human Health and Safety

Existing Conditions. Currently, the Army has a health and safety plan, which includes standard operating procedures and training, to prepare on-post workers and residents for a potential accidental release of agent. In addition, the Chemical Stockpile Emergency Preparedness Program (CSEPP) has been assisting, and would continue to assist the off-post population in planning, prepare, and training for a potential accidental release of agent.

Potential Accidental Releases of Agent. This section is applicable to all the destruction alternatives under consideration at PCD. Human health impacts from exposure to accidentally released mustard agent can be categorized as either lethal effects or sublethal effects. In this EIS, sublethal effects have not been quantified because of their great variation depending on exposure concentrations, the duration of exposure, and the number of people exposed. Potential fatality estimates in this EIS are based on the downwind no-deaths distance as computed with the Army's D2PCW atmospheric dispersion model (as discussed in Appendix H). The fatality estimates presented here are those that could result if the wind were to blow in the most unfavorable direction (usually toward the largest concentration of population). The assumed meteorological conditions are those that would disperse mustard agent in a manner that would produce the largest downwind extent of a lethal atmospheric plume.

To provide an upper bound estimate of the potential number of fatalities that might result from the most severe accident, the worst-case storage accident is analyzed in this EIS. This accident involves the crash of a large aircraft into a storage igloo followed by fire (see Appendix H). The lethal plume resulting from such an unlikely occurrence would not travel more than about 19 miles (30 km) from the release point. Under the most unfavorable meteological conditions, this accident could potentially cause 290 fatalities among the off-post residential population. The estimated number of potential fatalities for this accident under more typical meteorological conditions would be 2.

Appendix H also evaluates the consequences from a “worst-case” accident at a neutralization facility, as well as at a baseline incineration facility. Appendix H shows that the downwind no-deaths distance associated with such hypothetical facility accidents would be 5 miles (9 km). If the “worst-case” facility accident were to occur under the most unfavorable meteorological conditions, it could potentially cause 2 fatalities among the residential population around PCD. If this accident were to occur during more typical meteorological conditions, there would be no off-post fatalities.

The dose-exposure values used in the above estimations are applicable to healthy adult males. If young and old persons were more susceptible to exposure to mustard agent than healthy adult males, fatalities could be higher than estimated above. Executive Order 13045 (*Protecting Children from Environmental Health Risks and Safety Risks,* April 1997) requires Federal agencies “to identify and assess environmental health risks and safety risks that may disproportionately affect children.” Appendix H presents a sensitivity analysis that considers the increased susceptibility of the young and the old to chemical agent exposure. The results are summarized below.

About 36% of the population in Pueblo county is older than 65 or younger than 15. The analysis in Appendix H indicates that if old and young people were 5 to 10 times more sensitive to agent than healthy adults, the overall number of estimated off-post fatalities would probably be about 2.1 times the estimates reported above. Thus, children and older adults could be disproportionately affected by an accidental release of mustard agent. However, the potential for adverse impacts, disproportionate or otherwise, would be smaller for the proposed destruction activities than for continued storage at PCD, because the largest hypothetical accidents during continued storage could create a lethal hazard that extend over a greater downwind area than would the largest such accidents under either of the destruction alternatives (i.e., neutralization or incineration facilities).

All fatality estimates are based on residential population statistics and thus are more closely associated with nighttime distributions of population than with daytime distributions. Daytime activities lead to different distributions of population and potentially different fatality estimates. However, the meteorological conditions needed to propagate lethal doses of mustard agent 19 miles (30 km) from PCD can be associated almost exclusively with nighttime hours.

4.22.6 Soils

Mustard agent released to the atmosphere as fine particles or droplets would settle on land surfaces and would degrade over a period of a few days to a maximum of 3.5 months. Off-post soil contamination would be negligible. Pools or particles of mustard located near the accident site on-post would be removed during cleanup operations. Accidental spills of mustard occurring either during handling or while in transit to the facility would likely infiltrate surface soils before cleanup operations could begin. These soils, too, would be removed during cleanup. In the very unlikely event of a large accidental release of mustard agent into the atmosphere, soils could be contaminated several miles downwind. However, the contamination would degrade quickly, as described above. For all cases, no long-term impacts to surface soils would occur. Any contaminated soils that were cleaned up would be disposed of in accordance with applications regulations.

4.22.7 Groundwater

In the unlikely event that cleanup activities were delayed such that mustard agent spilled during an accident infiltrated to groundwater, the mustard would be transported less than 100 ft in groundwater before decomposing and would remain on-post. No off-post impacts would be expected to occur.

4.22.8 Surface Water

Mustard agent could be released in accident scenarios involving the on-post storage area or the MDB. The agent would be deposited on water bodies as fine particles. Particles deposited on surface water would degrade to 0.01% of their original concentration from within 80 min to 16 days, depending on water turbulence and temperature.

4.22.9 Terrestrial Habitats and Wildlife

The potential impacts to ecological resources from accidents are summarized in Table 4.41. Impacts of accidents from agent destruction facilities associated with each of the four destruction technologies would be essentially the same as discussed in further detail below.

Ecological impacts from a major accident associated with continued long-term storage (aircraft crash into a chemical munitions storage igloo) were assessed on the basis of deposition and atmospheric concentration estimates by using the D2PC model (Whitacre et al. 1986). This model takes into account historical atmospheric data and incorporates detailed information on the type of accident, agent involved, and type of release when it estimates atmospheric dispersion and deposition.

No data were found on the exposure of native vegetation and wildlife to chemical agents under field conditions. The D2PC model projected that the deposition plume areas would be elliptical in shape and would occur mostly downwind of an accident. The locations and geometries of the plume areas would vary depending on the atmospheric stability and wind direction at the time of an accident. At PCD, the prevailing winds that would result in the greatest consequences from an accident would be from the north and northeast. A release of agent HD would thus have a higher probability of affecting ecosystems located south and southwest of the agent destruction facility.

Acute effects from an accidental release would occur quickly after exposure. Some deaths would occur to exposed wildlife located in an area close to the site of the accident, particularly species with small home ranges (e.g., small mammals, reptiles, and amphibians), since they would remain in the agent HD exposure plume during the accident. Mammals and birds within this distance that did survive would suffer from blistering skin, irritation to the respiratory system, eye irritation, and other chronic effects known to affect humans and laboratory animals (U. S. Army 1988; see also Appendix B).

Table 4.41. Effects of accidents on ecological resources

Impact Category	Proposed Actions[a]	No Action
Terrestrial vegetation	None	None
Wildlife	Major; of short duration; deaths of wildlife from HD inhalation within close-in distances downwind of site; species with limited mobility and small home ranges would be severely impacted	Major; of short duration; death of wildlife within close-in distances downwind of site; some sublethal effects beyond 19 miles (30 km) from the accident.
Protected species	Major; of short duration; death of black-tailed prairie dogs in Areas B and C; death of, or serious injury to state-protected fish, and state-listed aquatic and wetland species of concern	Major; of short duration; death of black-tailed prairie dog and mountain plover at close-in distances downwind of site; some sublethal impacts beyond 19 miles (30 km); death of, or serious injury to state-protected fish, and state-listed aquatic and wetland species of concern
Aquatic ecosystems	Moderate; of short duration; death of aquatic animal species in creeks, in Lynda Ann Reservoir, AWS pond, and spring-fed pond	Moderate; of short duration; death of aquatic animal species in creeks, Lynda Ann Reservoir, AWS pond, and spring fed pond; some sublethal impacts beyond 19 miles (30 km)
Wetlands	Moderate; dry deposition of HD on vegetation at spring fed pond and Lynda Ann Reservoir; death of wetland species	Same as for proposed action
Sensitive plant communities	None	None

[a]Proposed actions are: baseline incineration, modified incineration, neutralization with SCWO, and neutralization with biotreatment. Effects of accidents would be similar for all of the action alternatives.

No data were found on the uptake of agent HD through ingestion under field conditions. Some agent HD deposited on vegetation, particularly in areas close to the release, could be taken up by herbivores during the first few days after the accident. Hydrolysis of agent HD would likely occur during the first 1 or 2 days after the accident; it would result in various degradation products. No data were found on exposures of wildlife to agent HD degradation products under field conditions. A recent article that reviews the toxicity of chemical warfare agent degradation products suggested that thiodiglycol (TDG), a breakdown product of agent HD, could persist in soils following an accidental release (Munro et al. 1999). Even if all of the agent HD within this area degraded to the TDG (low likelihood of occurrence), it would be highly unlikely that an herbivore would receive a dose through the food pathway that would be above the levels of concern reported for laboratory rats (Munro et. al. 1999).

The long-term impacts on terrestrial ecosystems from an accident releasing mustard gas would likely be minimal. The persistence of agents HD and HT in soil and on vegetation is estimated to range from one day to about one week (U.S. Department of Health and Human Services 1992). The high reactivity of agent HD with water suggests that bio-uptake and biomagnification in local ecosystems would be unlikely. Within a plant's vascular system, hydrolysis would likely cause agent HD to break down before it could become concentrated in plant tissues (U.S. Department of Health and Human Services 1992).

4.22.10 Aquatic Habitats and Fish

An accidental spill of agent inside the destruction facility during operations would affect only a small area within the facility before being quickly contained and cleaned up. No impacts to aquatic biota would occur. The impacts on aquatic biota of a bounding case accident would differ little under any of the incineration or neutralization alternatives.

The plume of mustard agent resulting from the bounding case accidental release during continued storage could extend over several square miles. Information on the toxicity of mustard agent to aquatic organisms is extremely limited, partly because mustard is difficult to test in aqueous media due to its low solubility and its specific gravity being greater than that of water; however, one study by Buswell et. al (1944) reported some success in testing the toxicity of various mustard agents on a number of freshwater species. Results indicated that acute toxicity (here measured as the dose lethal to 50% of tested organisms over a 20- to 30-day period of exposure) in fish and crayfish occurs at 2 mg/L or higher. Note however that acute toxicities are generally determined in 96-hr tests rather than 20-30 day tests. A 96-hr test would undoubtedly result in a considerably higher concentration (i.e., lower toxicity) of mustard before acute toxicity was detected. In any event, mustard deposition onto surface waters during plume passage could exceed the level of 2 mg/L in the top few centimeters for a period of a few hours or days, certainly much less than 20 - 30 days, before mixing and hydrolysis have proceeded very far. Hydrolysis is likely to rapidly reduce mustard agent concentrations to levels that are non-toxic to aquatic biota (however, should the mustard agent collected on the surface agglomerate into relatively large droplets, these droplets could sink to the bottom where they might persist for periods long enough to be ingested by benthic organisms). The principal hydrolysis product of mustard, thiodiglycol, is essentially non-toxic to aquatic species. Although other products of hydrolysis could also be present, their concentrations would be much lower than either mustard or thiodiglycol concentrations, and hence would be less toxic to aquatic biota.

Aquatic organisms inhabiting the spring-fed pond on Boone Creek, southeast of Munitions Storage Area A, would likely die from initial exposure to mustard. Within a relatively short period, HD would hydrolyze and not persist within the water column. Some impacts on aquatic invertebrates and fish could occur in Lynda Ann Reservoir, AWS Pond, and Chico Creek after the accident. Among the aquatic species that would likely experience injury or death are the Colorado state-listed endangered southern red-belly dace and the state-listed "species of concern," the plains minnow. The extent of impacts to aquatic organisms would depend on the sensitivities of individual species, the aerial concentration and deposition of mustard, and the amount of time the mustard would take to break down. Mustard would hydrolyze in water bodies more rapidly during windy conditions, when more turbulence typically occurs at the water surface.

The long-term impacts on terrestrial and aquatic ecosystems from an accident releasing mustard gas would likely be minimal. The persistence of mustard in soil and on vegetation is estimated to range from one day to about one week (U.S. Health and Human Services 1992). The high reactivity of mustard with water suggests that bio-uptake and biomagnification in local ecosystems would be unlikely. Within a plant's vascular system, hydrolysis would likely cause mustard to break down before it could become concentrated in plant tissues (U.S. Department of Health and Human Services 1992). Within a period of time expected to be no longer than a few months, recovery of aquatic populations would begin.

Because complete destruction of mustard agent at PCD would remove permanently the threat of an accidental release, the potential impact from accidents to aquatic life would be less for the proposed action than for the no-action alternative.

4.22.11 Protected Species

The following discussion presents the potential environmental consequences to protected species from the worst-case storage accident. Impacts of accidents from an agent destruction facility associated with any of the four technology alternatives would be essentially the same as discussed in detail below.

Impacts of accidents to representative wildlife species, including the black-tailed prairie dog, a federal candidate species, are discussed in Sects. 4.22.1.9. Acute effects from an accidental release would occur quickly after exposure. Some deaths would occur to exposed wildlife located close to the accident site, particularly species with small home ranges (e.g., small mammals, reptiles, and amphibians), since they would remain in the agent HD exposure plume during the accident. Some deaths could also occur at greater distances downwind of the accident site. Mammals and birds within these areas that did survive would suffer from blistering skin, irritation to the respiratory system, eye irritation, and other chronic effects known to affect humans and laboratory animals (U. S. Army 1988; see also Appendix B). Any of the federal and state listed species in these areas, including the black-tailed prairie dog, swift fox, mountain plover, and loggerhead shrike could be so affected. There could be some sublethal effects to sensitive species beyond 19 miles (30 km) for the worst-case accident associated with the continued storage.

4.22.12 Wetlands

Wetland biota would be adversely affected by an accidental release of mustard agent in about the same way aquatic biota of streams and ponds would be affected (see discussion of impacts of accidents on aquatic habitat and fish in Sect. 4.22.10 above). The plains leopard frog and the northern leopard frog, both Colorado state-listed species of concern, would be among the wetland biota that could be injured or killed following such an accident**.** Nevertheless, within a period of time expected to be no longer than a few months, recovery of wetland populations would commence.

4.22.13 Cultural Resources

An accident involving the release of mustard agent to the environment could result in impacts to on-post and off-post cultural resources within the exposure pathway. Exposed surfaces of archaeological sites, TCPs, or historic structures could become contaminated. At a minimum, public access to these cultural resources would be temporarily denied until contamination was degraded by exposure to light and moisture or by active decontamination. Only temporary impacts (i.e., access restrictions) would be expected on cultural resources located downwind in the unlikely event of the worst-case storage igloo accident 19 miles (30 km) (see Appendix H). Access restrictions could last for a few days or longer, depending on the degree of contamination and the length of time required to certify that access could again be permitted. It is expected that low levels of mustard agent contamination would degrade in a few hours under certain conditions, while larger quantities might take several weeks to degrade.

Historic properties located downwind of the 19 miles (30 km) accident could be affected by extended restriction periods until the contaminant was degraded by light and moisture. If the contaminant was deposited as a liquid, the Army might require that the properties of concern undergo various decontamination procedures before being released for access by the public. Such decontamination procedures could damage the property. If decontamination efforts were not successful, a property might have to be destroyed by thermal treatment. However, extended public access restrictions lasting until the contaminant has dissipated would be likely to preserve significant properties. Deposition of liquid agent in quantities that would require destructive decontamination would most likely be confined close to the point of the accident and within the PCD boundaries.

4.22.14 Socioeconomics

An accidental spill of mustard agent would likely be limited to a small area of land in the vicinity of the destruction facility site or munitions storage area, but could result in a high level of contamination of soils in the immediate vicinity of the spill. As a result of such a spill, only a small area of land would be affected. Thus, there would be no impacts on off-post socioeconomic resources.

An accidental release of mustard agent into the atmosphere could have catastrophic impacts on socioeconomic resources in Pueblo County and surrounding counties. The most severe accidents would involve continued storage, and could have an estimated human health impact distance of 19 miles (30 km) (see Appendix H). The general nature of socioeconomic impacts from severe accidents can be placed in perspective using existing literature on the social and economic effects of other localized disasters in which the release or near-release of toxic chemicals affected community resources either temporarily or on a long-term basis.

The largest accident during destruction facility operations would be smaller than a continued storage accident, but could result in loss of life and negative economic impacts from the contamination of the environment, including water, food supplies, and structures. Furthermore, under certain conditions mustard agent can remain in the environment for long periods of time while retaining its toxicity. The economic activity of the local area would be immediately reduced because of the inability to use the existing infrastructure and resources currently available. At the same time, economic resources would be directed toward recovery and restoration. As in other events involving hazardous chemicals, the length of time for restoration would depend on the amount of agent released, the size of the contaminated area, and the time needed to decontaminate.

Impacts to Agriculture. The effect of an accidental release on agricultural resources would depend primarily on two factors: 1) the extent of agent dispersal and 2) the protective actions taken. The precautions taken to protect agricultural resources and to prevent the public from consuming affected agricultural products would help avoid some of the direct impacts of an accident. As discussed below, livestock grazing off-post, downwind from PCD, would be precluded until the contamination declined to levels at which animals could safely graze without experiencing adverse effects, and at which time their meat or milk products would be safe for human consumption. The use of land within contaminated areas for growing crops and the consumption of crops produced by affected soils also would be temporarily discontinued. Agricultural crops contaminated with chemical agent resulting from direct deposition would not be suitable for human consumption. The length of time during which grazing and crop growing would be precluded following an atmospheric release depends on the amount deposited and persistence of the mustard agent. Although the potential impacts of a release on agricultural resources around PCD would be temporary, they could be significant. It is difficult to estimate the economic losses that would be associated with such impacts to agriculture, but if during the worst-case storage accident, the equivalent of half of Pueblo County's 1997 agricultural production were affected, losses from livestock and crop sales could be as high as $15 million to $20 million each year the area is contaminated. In addition, this estimate of economic losses could be low if an accidental release resulted in the "stigmatization" of Pueblo County livestock and crops, wherein sales might suffer from buyers' perceptions about agricultural products from the affected area long after actual contamination is no longer an issue. CHPPM is preparing a study on the potential impacts of an routine release of agent on agricultural production. The results of this study will be released and evaluated before destruction operations at PCD commence.

Other Impacts. In the event of a major accidental release, it is likely that some areas and structures would have to be abandoned temporarily. If the affected areas and structures were in a heavily-populated area with many houses or in a heavily-developed commercial or industrial site, there would be adverse impacts to quality of life, including effects related to mental health and well-being, social structure, and well-being of the affected community (U.S. Army 1988).

If an accidental release of mustard agent were to result in the temporary suspension of agricultural activity, the number of migrant and seasonal farmworkers, other transients, and low-income groups might suffer disproportionately high and adverse impacts. During such an event such disenfranchised groups may not have ready access to health care or may in positions without vehicle egress that could cause them to be in areas longer than other less vulnerable groups, causing them longer exposure that could result in adverse health consequences.

4.23 SUMMARY OF CUMULATIVE IMPACTS

This section summarizes the key points from the assessments of cumulative impacts presented in the previous sections addressing each environmental resource area. For the purpose of identifying pertinent data concerning potentially affected environmental resources for this FEIS, numerous regional private and government organizations have been contacted, particularly in Pueblo County. During these contacts, information was also sought concerning other past, present, and reasonably foreseeable future activities that, in combination with the proposed action, might result in cumulative impacts within the depot or in the surrounding area. The assessment of the resulting information resulted in a finding that any such impacts would be temporary and would not be expected to be significant.

The other activities on the installation with the potential to contribute to cumulative impacts result from efforts to redevelop portions of the installation for new uses. These activities, like the construction and operation of the demilitarization facilities, are located within the installation boundary in previously disturbed areas. They are located some distance away from the proposed demilitarization facilities. Utility upgrades associated with the demilitarization construction could improve utility services for these other users. The off-post areas near the installation are primarily in agricultural or light industrial use.

Current activities on the installation include office work and warehouse operations. Neither activity has the potential to combine with any of the four alternatives to cause cumulative health effects to installation and off-post personnel, either through routine operations or accidents. Additional noise sources should not produce perceivable differences in sound level. Additional industrial development on the installation and nearby should produce only small, if any, aesthetic impacts.

The resource subject to the greatest potential cumulative impact is water. Any of the alternative technologies could divert water from off-post users in the case of a severe shortage, but the quantities of water needed to construct and operate the new facilities would not be so great as to cause the installation to exceed the amount allowed under the existing Colorado Water Permit. Cumulative impacts with other installation activities could include further depletion of the groundwater resource and a possibility of a slight, temporary deterioration in water quality. Groundwater users located downgradient and on-post could experience somewhat reduced water availability, a slight deterioration of water quality, and/or increased cost. Off-post water users are not likely to be affected.

Based on the most recent estimates, the neutralization with SCWO alternative would require the least amount of water—about 24 acres-ft/yr for an estimated 28-months of operation, compared to 44 acre-ft/yr for a 30-month period of operation for modified incineration. Baseline incineration is predicted to require about 50 acre-ft/yr over a 65-month period, while neutralization with biotreatment would need about 37-acre-ft/yr for three years.

The increased groundwater withdrawal could produce low to moderate adverse effects on surface water flow and water levels in on-post streams, ponds and wetlands. Fish and other species found in these environments could also be slightly impacted. Two state-listed species of concern, the plains and northern leopard frogs, possibly may experience temporary population declines in any wetlands indirectly affected by groundwater withdrawals.

However, it is very difficult to predict the impact, if any, on the aquifer. The water to be withdrawn is within the amount allowed by the existing permit. In any case, the chemical weapons destruction program is a short-term effort. Construction, operations, and decontamination and decommissioning would each take two to three years, depending on the technology alternative employed. After that time, no additional groundwater would be removed and any cumulative impacts should be reversed.

4.24 OTHER IMPACTS

4.24.1 Irretrievable and Irreversible Commitment of Resources

In implementing the proposed action or the no-action alternative, some of the resource commitments would be irreversible and irretrievable; in other words, the resources would be neither renewable nor recoverable for further use. Generally, resources that may be irreversibly or irretrievably committed by construction and operation of the proposed destruction facility include biota destroyed in the vicinity of the site, construction materials that could not be recovered or recycled, and energy sources or materials consumed or reduced to unrecoverable forms of waste.

Resources used during construction of the destruction facility would include cement, gravel, ore used for steel, natural gas, diesel fuel, gasoline, and water. Construction activities and destruction operations require a commitment of human and financial resources. Commitments of machinery, vehicles, and fossil fuels also would be required during the project. None of these resources is in short supply relative to the size and location of the proposed action.

In accordance with Pub. L. 99-145, equipment and structures comprising the destruction facility would have to be dismantled and disposed of following destruction of the chemical stockpile at PCD. However, in November 1989, the House and Senate Appropriations Committee of Conferees in Title VI of the 1990 DAC Report 101-345, entitled *Chemical Agents and Munitions Destruction, Defense*, directed the Army to investigate and report on the feasibility and desirability of using chemical weapons destruction facilities for other purposes after destruction of the stockpile. Reuse of these facilities, however, is currently precluded by Pub. L. 99-145, which requires the demilitarization facilities to be used for the sole purpose of destroying the chemical stockpile and to be decommissioned following the completion of that mission. The land on which the proposed destruction facility would be constructed could be reused by other U.S. Army functions after completion of decommissioning; however, it should be noted that PCD is scheduled for base realignment following the completion of the demilitarization activities (U.S. Army 1992).

The no-action alternative (continued storage) would also require commitment of resources for maintenance of the stockpile. However, fewer resources would be irreversibly and irretrievably committed than under on-site destruction.

4.24.2 Long-term Impacts vs. Short-term Use

The proposed action would involve a short-term use of land and resources, as well as minor, short-term increases in suspended particulates and plant emissions associated with construction and operation of the destruction facility. These would be more than offset by the elimination of the risks of continuing to store the chemical agents at PCD. The greatest potential adverse effects would be primarily those associated with accident conditions and would be concerned with threats to human health, ecology, and agriculture. Elimination of the chemical agent stockpile would eliminate these risks and would also provide additional area within the PCD installation for other uses.

Potential environmental impacts from construction, normal operation, and possible accidents associated with the estimated 6-year duration of the proposed action would be generally less severe than the potential risks and adverse impacts from continued storage, which would continue much longer than on-site destruction.

The Army would generate approximately 8,100 metric tons (8,900 tons) of scrap metal resulting from operation of the proposed destruction facility. This material—formerly the bodies of munitions—would be recycled into the scrap metal market and could offset the potentially adverse environmental effects, as well as reduce the energy requirements, of mining and smelting virgin ores.

4.25 CLOSURE AND DECOMMISSIONING

With passage of Public Law 99-145 in 1986, Congress directed the Army to destroy the U.S. Stockpile of chemical munitions, and mandated the dismantling and destruction of the demilitarization equipment and buildings upon completion of the stockpile destruction activities. Subsequently, in 1989, Congress issued the 1990 Defense Appropriations Conference (DAC) Report, 101-345, in which it directed investigation and reporting on the feasibility and desirability of using the destruction facilities for other purposes after the stockpile is destroyed. At that time the proposed incineration facilities were found to be not well suited for many of the possible uses that were investigated , and no recommendation for future use was made (Goldfarb et al. 1991). Nevertheless, with passage of the DOD Appropriations Act, 2000 (Public Law 106-79) in October 1999, Congress modified federal law to remove the mandate for dismantling the destruction facility, if the administration of the state in which it is located so chooses. This has become known as the “Right of First Refusal”.

As a result of Public Law 106-79, the Army is now studying the feasibility and cost-effectiveness of using the chemical munitions destruction facilities to destroy the Non-stockpile Chemical Materiel (NSCM) that is stored at the same locations. Nevertheless, the Army currently intends to dismantle and close the PCD facility upon completion of the stockpile destruction activities. That intent is the motivation for providing the following discussion of potential impacts of closure and decommissioning of the destruction facility eventually constructed at PCD.

To date no closure plan has been developed to present plans and methods for closure of the chemical munitions destruction facility at PCD. No closure plans have been developed for any of the proposed locations in the continental U.S. where destruction facility are to eventually be constructed and operated. JACADS is the only such chemical weapons destruction facility to have completed of its mission and to have been the subject of the development a closure plan. Although the JACADS plan (U.S. Army 2000) would not be directly applicable to PCD, for purposes of this assessment, it is assumed that the JACADS plan would bear some similarities to closure plans for incineration facilities in the U.S. Therefore, it provides the best basis for the discussion of the potential impacts of closure and decommissioning presented in this section. Some of the key points are summarized below.

Engineering Changes and RCRA. The JACADS facility will be closed through an integrated sequence of partial closures and changes in function. JACADS decommissioning activities are planned, engineered, and implemented through the use of Engineering Change Proposals. For example, it is anticipated that before the chemical demilitarization operations are completed on Johnston Island, portions of the storage area will undergo a change in function from munitions storage to a hazardous waste storage area. The affected bunkers will be used for storage of certain process and non-process wastes awaiting incineration (e.g. carbon filters, demilitarization protective ensembles, etc.). Additionally, the spent decontamination solution storage tanks and all associated equipment will be dismantled and thermally treated in the MPF. Prior to decontamination/dismantlement of the existing exhaust system, a new system will be installed for the MPF, LIC, and other areas in the MDB.

Use of Furnaces. The existing JACADS furnaces will be utilized during the closure campaign. Large quantities of closure waste will be generated as a result of the dismantlement of decommissioned equipment in the MDB. Most of this closure waste will be processed through the MPF in order to reach the level of decontamination established. In the case of baseline incineration, the MPF may be used to co-process waste (primarily metals) associated with the munitions machinery while the LIC continues to process munitions and agent.

Closure Assessment. During the JACADS closure campaign, a final closure investigation/assessment will be performed to determine the nature and extent of any potential release of hazardous waste and/or hazardous constituents from the hazardous and solid waste management units.

Decontamination. Cleanliness criteria have been established for the JACADS buildings, structures, and associated equipment for demilitarization operations. The Army has also developed specific decontamination criteria to ensure safe usage of the equipment and buildings associated with agent management. These same criteria will be used during the closure campaign.

Decontamination methods for agent contaminated areas will involve the following techniques, as appropriate for each situation:

- Chemical decontamination
- Decontamination solution; sodium hydroxide (NaOH) and sodium hypochlorite (NaOCl)
- Caustic or bleach mixed with surfactants
- Pressurized hot water
- Pressurized hot water mixed with caustic or bleach
- Epoxy spray painting
- Concrete surface layer removal
- Concrete curb removal

Decontamination methods for non-agent contaminated areas will address hazardous contaminants other than agent. Cleaning areas of loose debris should be sufficient in most cases, with other measures to be used as necessary including physical methods (e.g., grit blasting or hydroblasting) and liquid method (e.g., washing, steam cleaning, and use of cleaning solutions).

All decontamination solutions and residues will be collected, containerized, and disposed of in accordance with existing standards and requirements. Furthermore, a detailed description of the steps needed to accomplish closure will be prepared in accordance with existing site decontamination procedures or with recommendations made following closure sampling and evaluation of data. The partial and final closure activities to be described include removal or decontamination of all contaminated hazardous waste residues, containment system components, equipment, structures, and soils (U.S. Army 2000).

4.25.1 Site and Facilities

Complete destruction of the PCD chemical munitions stockpile followed by closure and dismantling of the destruction facility would free up the site and surrounding facilities for reuse.

4.25.2 Land use

Closure and decommissioning of chemical demilitarization facilities at PCD, whether they be incineration or neutralization facilities, would likely have positive effects on both on-post and off-post land use. For on-post, closure and decommissioning would make more land available for the various uses proposed in the *Reuse Development Plan Update* (PDADA 2000a). For both on-post and off-post, closure and decommissioning would mean that the single largest threat to existing and proposed land uses (i.e., the accidental release of mustard agent into the atmosphere during either continued storage or destruction) would be removed.

4.25.3 Water Supply and Use

Closure and decommissioning would likely have positive effects on both on-post and off-post water supply and use. First, it would end the diversion of water to chemical agent destruction from other on-post and off-post uses. This would make more water available for the various on-post land uses described in the *Reuse Development Plan Update* (PDADA 2000a) and for off-post uses. Second, closure and decommissioning would eliminate the potential impacts to water of an accidental release of mustard agent during either continued storage or destruction.

4.25.4 Electrical Power Supply

Closure and decommissioning would likely have positive effects on the electrical power supply by ending the diversion of electricity to chemical agent destruction from other on-post uses. This would make more electrical power available for the various on-post land uses described in the *Reuse Development Plan Update* (PDADA 2000a).

4.25.5 Natural Gas Supply

Closure and decommissioning would likely have positive effects on the natural gas supply by ending the diversion of natural gas to chemical agent destruction from other on-post uses. This would make more natural gas available for the various on-post land uses described in the *Reuse Development Plan Update* (PDADA 2000a).

4.25.6 Waste Management

There has been no detailed analysis of the wastes that may be generated from the closure and decommissioning of an incineration or a neutralization facility. A closure and decommissioning plan has been developed for JACADS. Table 4.42 presents the waste categories and estimated quantities from the JACADS closure and decommissioning plan. Approximately 90%, 2.5 million kg (5.4 million lb), of the wastes listed in the table would be hazardous wastes. There would be approximately 250 thousand kg (545 thousand lb) of nonhazardous wastes.

The Army does not plan to have an on-site landfill. However, an on-site landfill could be required if building demolition is required for closure. Assuming no building demolition is required, closure wastes will primarily be treated in the MPF to minimize the amount of waste that must be disposed of off-site. At JACADS, 318,000 lb of waste carbon, 300,000 lb of halogenated plastics and a variety of other waste products achieve 99%+ weight/volume reductions in the furnaces. The modified baseline facility is being designed to minimize the amount of agent contamination and, as a consequence, minimize the amount of closure wastes that would be generated. Based on these steps, it is expected that the quantity of closure wastes would be less than that generated at the baseline facilities. For example, the modified baseline facility design would include a freezing step that should virtually eliminate the probability of agent spills from a munition and reduce the agent vapor levels in process areas, thus reducing potential and actual contaminated areas and equipment items. In addition, munitions would not be drained. As a result, MDM, agent holding tanks, LIC, LIC PAS and associated piping are not necessary. These components would not require decontamination during closure.

Closure wastes that would be generated at the modified baseline facility would consist of the following types:

- Wastes that are similar to operational wastes. These include wastes that are generated during closure when the furnaces are operated to treat operational secondary wastes or other closure wastes including maintenance wastes, tools, absorbents, SDS, DPE, brine, spent carbon, used equipment, instrumentation.

Table 4.42 JACADS Closure and Decommissioning Plan waste stream summary

	Munitions Campaign				Closure Campaign		
Waste feed designation	Stored as of April 00 (lb)	End predicted increase (lb)	USACAP waste Inventory (lb)	Co-processing (lb)	SSOs (lb)	Secondary (lb)	Total weight (lb) of the waste feed
Inert bulk solid waste-bulk equipment	510800	53400	6400	32600	930200	204200	1737600
Inert bulk waste-piping & fittings	0	0	0	1600	26500	0	56100
Inert bulk solid waste-structural steel & ripping/cond supports	0	0	0	100	134300	0	134300
Inert bulk solid waste 2" foam Core panels	0	0	0	0	173800	0	173800
Inert bulk solid waste-concrete	0	0	0	0	118500	0	118500
Inert bulk solid waste-valves & metal parts <=5% plastics	27600	6900	0	1600	256500	0	292600
Inert bulk solid waste-aluminum	700	140	0	1000	900	280	3020
Combustible bulk waste-electrical parts/ instruments>5% plastics	1200	240	0	1600	3800	480	41520
Combustible bulk solid waste Non-halogenated plastics, wood doors	49000	11100	400	3700	74600	23600	162400

Table 4.42 (continued)

Waste feed designation	Munitions Campaign: Stored as of April 00 (lb)	Munitions Campaign: End predicted increase (lb)	Munitions Campaign: USACAP waste Inventory (lb)	Co-processing (lb)	Closure Campaign: SSOs (lb)	Closure Campaign: Secondary (lb)	Total weight (lb) of the waste feed
Halogenated waste-cable/conduits	34300	6900	0	3500	54200	13700	112600
Halogenated waste-piping, fittings, valves and misc.	44400	7500	0	200	74100	17050	143250
Halogenated waste-DPE Suits	173000	34600	0	0	0	41000	248600
Polystyrene &Polyethylene	22600	3700	8400	0	0	8600	43300
Spent HEPA & prefilters	6000	0	1500	0	2600	0	10100
MDB sludge	6000	1200	0	0	0	2400	9600
SDS	220	50	0	0	0	2300000	2300270
Agent contaminated spent hydraulic fluid	4000	800	0	0	11000	1600	17400
Agent contaminated charcoal	208600	0	39000	0	0	72700	320300
Total	1088420	126530	55700	45900	1955200	2686610	5957360

Notes: 1. Based on 4000 lb/tray of metal.
2. Based on 400 lb/tray of DPE suits.

- Wastes from the decontamination and dismantlement of equipment and structures (including secondary wastes generated from these activities, such as SDS and DPE). These include debris wastes such as steel from conveyors; tanks; piping located in toxic areas; concrete from walls, floors, and ceilings of areas that may be potentially contaminated with agent; and SDS used to decontaminate equipment and structures.

For agent-contaminated closure wastes, the preferred treatment method will be by on-site incineration. Since the MPF can treat most, if not all, types of materials expected to be present in the closure wastes (e.g., metals, concrete, stainless steel, plastics, and halogenated plastics), the MPF will be the primary treatment alternative for contaminated closure wastes. All closure wastes that are not contaminated or contaminated below exit levels could be disposed of at off-site TSDFs or landfills. The MPF components themselves could be considered 5X and could be disposed of off-site. The only components of the MPF charge system (conveyors and charge airlock) that are not exposed to 5X conditions would be treated in the MPF as well. Treatment of wastes that are generated during operations as well as closure would be treated similarly to operations. Certain wastes that would be generated toward the tail end of closure (for example, the final batch of carbon, part of the HVAC) would need to be disposed of at an off-site location.

The impacts from disposing of the nonhazardous wastes at permitted off-site landfills would not be large. The quantities of hazardous waste would be substantially reduced from the values given in Table 4.42. For instance the mass of spent decontamination solution (2,300,270 lb) would be reduced by 99+%. Similar reductions could occur for other hazardous waste with large water or organic components. With these large reductions in mass and volume, it appears that impacts to TSDFs accepting the hazardous wastes would not be large.

4.25.7 Air Quality-Criteria Pollutants

Closure and decommissioning would generate fugitive dust in quantities similar to those involved in site construction; these impacts were analyzed in Sect. 4.7. It is not expected that any health-based air-quality standards for criteria pollutants would be exceeded. Federal and state air quality regulations will be adhered to.

4.25.8 Air Quality-Hazardous and Toxic Materials

Closure and decommissioning would not be expected to occur until toxic and hazardous substances have been removed from the site; therefore, no air quality impacts of toxic and hazardous substances would be expected.

4.25.9 Human Health and Safety

The types of impacts that may occur during decommissioning would be similar to those that accompanied the initial construction of the facility. These construction impacts are discussed in Sects. 4.9.2 and 4.10.3. There would be no significant adverse health impacts for the closure and decommissioning of this facility to the on-post workers and residents and the off-post population.

4.25.10 Noise

Closure and decommissioning would not be expected to generate appreciable continuous noise. However, the proposed structures are designed to withstand considerable stresses without great damage, which complicates disassembly and decommissioning. Sporadic noise from saws, jackhammers, etc. may lead to sound pressure levels as high as 95 dB(A) at a distance of 15 m. Moreover, it is possible that explosives would be used to demolish some structures. The resulting noise would be expected to be audible at the site boundary, and, in some cases, would be audible, and possibly temporarily distracting, at outdoor locations around the nearest residence.

4.25.11 Visual Resources

Closure and decommissioning would have a positive effect on visual resources by removing the chemical agent destruction facilities (especially the stacks) and replacing them with wildlife habitat.

4.25.12 Geology and Soils

No adverse impacts would be expected to the soils or mineral resources from facility closure and decommissioning. Negligible to no soil disturbance would be associated with the closure activities. Economic geologic resources would be either spread to the existing terrain or could be use for other purposes at PCD. Access to potential mineral resources located beneath the facility could be exploited.

4.25.13 Groundwater

No adverse impacts would be expected to the groundwater resource from facility closure and decommissioning. Groundwater would not be affected by closure.

4.25.14 Surface Water

No adverse impacts would be expected to the surface water resource from facility closure and decommissioning. Negligible to no soil disturbance would be associated with the closure activities that could potentially degrade surface water.

4.25.15 Terrestrial Habitats and Wildlife

If the facility were to be removed from the site then approximately 85 acres of terrestrial habitat would become available to undergo the natural successional sequence to shortgrass prairie.

4.25.16 Aquatic Ecology and Wetlands

Impacts of closure and decommissioning activities would be expected to be comparable to those encountered as a result of construction of any of the incineration or neutralization alternatives. With respect to wetlands and aquatic biota, therefore, adverse impacts on area wetlands, streams, and ponds would be negligible.

4.25.17 Protected Species

If the facility were to be removed from the site then approximately 85 acres of terrestrial habitat would become available to undergo the natural successional sequence to shortgrass prairie thereby potentially benefitting any protected species associated with this habitat type. Destruction and removal of the facility should have negligible and temporary impacts to any protected species surrounding the site.

4.25.18 Cultural Resources

Closure and decommissioning would likely have positive effects on cultural resources by removing the potential impacts of an accidental release of mustard agent into the atmosphere during either continued storage or destruction.

4.25.19 Socioeconomics

Closure and decommissioning would have both adverse and beneficial effects on socioeconomic resources in Pueblo County. Adverse effects would result primarily from losing the operations-related jobs, income, and public revenues described in Sect. 4.21.4. Beneficial effects would result primarily from the land and utilities (especially water) that would be made available for other productive uses and from decreased traffic on U.S. Highway 50. Also, closure and decommissioning would have the beneficial effect of removing a potential threat to the area's socioeconomic resources (i.e., the accidental release of mustard agent into the atmosphere during either continued storage or destruction).

4.25.20 Environmental Justice

Activities associated with decommissioning and closure of the destruction facility would be carried out in compliance with accepted environmental and occupational standards. Therefore, decommissioning and closure activities would not cause adverse human health or environmental effects on minority or lower-income populations.

4.26 MITIGATION AND MONITORING

Mitigation measures and monitoring (which can be considered a mitigation measure) help ensure that storage, handling, and destruction of the chemical munitions are carried out in a safe and efficient manner. Similarly, facility permitting (Sect. 4.27) can be considered a part of the mitigation measures because it requires advance consideration of potential health, ecological, and agricultural risks. Permitting also requires proof of capability to operate within limits that have been studied and set conservatively by regulatory agencies to provide an adequate margin of safety for the protection of workers, the public and the environment.

4.26.1 Safety Enhancements

The PMCD FPEIS (U.S. Army 1988a) identifies mitigation measures and safety enhancements that would reduce the probability and consequences of potential accidents. The performance of JACADS and DCD (incineration) and APG and NECD (neutralization) have resulted in further safety enhancements in designs. Implementation of lessons learned at these facilities is an important mitigation measure for reducing risk from destruction operations.

4.26.2 Personnel Reliability

Good hiring practices, training programs, and oversight of workers' performance contribute to overall personnel reliability which would be necessary to mitigate accidents that could result from human error. Accidents resulting from human error have been assessed through risk analysis. Planned screening procedures, hiring practices, and training procedures are outlined below.

4.26.2.1 Hiring practices and screening of employees

Operations and maintenance personnel expected to have access to agent would be required to enter the Army's Chemical Personnel Reliability Program (CPRP). This controlled access program provides a means of assessing the reliability and acceptability of individuals being considered for and assigned to chemical duties. Qualifying factors include competence, dependability, emotional stability, and positive attitude toward assigned duties and the objectives of the CSDP, CPRP, and ACWA programs. Disqualifying factors include alcohol abuse, drug abuse, negligence or delinquency in performance of duty, conviction for a serious offense by a military or civil court, any physical or mental condition that compromises the performance of an assigned duty, poor attitude, or inability to wear required protective clothing. Personnel security investigations that involve national agency checks by the Federal Bureau of Investigation would be conducted as part of this program. This could also involve written inquiries to listed references. The individuals would be interviewed by the certifying official, and all medical records would be reviewed by qualified medical personnel.

The operating and maintenance contractor would be required to establish a random drug testing program. Employees could be subject to verification by functional test, urine screening, search, or other action following guidelines of the Food and Drug Administration.

4.26.2.2 Training program

An integrated training program has been implemented to ensure that all facilities are operated in a uniform and consistent manner that provides protection to human health and the environment both on and off the facility site and to minimize factors that degrade human performance or increase the likelihood of human error. A central Chemical Demilitarization Training Facility (CDTF) has been constructed at APG. This facility is being used to provide initial and refresher training to operating and maintenance personnel from all the CONUS facilities. CDTF contains classrooms; a non-agent laboratory for sampling, analytical, and monitoring activities; an equipment area with major pieces of munition/bulk disassembly equipment; a control room with simulation capability; and a fully equipped DPE support area where personnel undergo rigorous training that includes classroom instruction and actual hands-on experience with simulated chemical agent. Personnel are graded for their response to simulated failures and emergencies. After their training is completed at CDTF, the operators undergo additional hands-on training at the PCD facility. Prior to the start of operations, operators are required to demonstrate competence in performing their assigned duties through written and oral exams and by performing exercises (under normal and emergency situations) while being observed by a certifying official.

4.26.2.3 Human-initiated accident scenarios

Human error plays a role in a few of the accident scenarios considered in the assessment of potential impacts in this FEIS; consequently, mitigation to reduce the probability and/or consequences of accidents involving human error would help to reduce the overall risk associated with the proposed action. Of principal interest are those accidents with lethal plumes traveling past PCD boundaries [i.e., those credible events with no-deaths distances exceeding 1.7 km (1.1 mile)] and that are initiated by human error.

A review of the accident database for PCD (see Appendix H) shows that for transportation accidents initiated by human error, only two were found to result in a plume that travels beyond installation boundaries under unfavorable meteorological conditions. No human initiated accidents were found that would result in a plume that would travel beyond installation boundaries under most likely meteorological conditions (when transportation is likely to be taking place).

A number of mitigation measures are planned, and others are under study, that would reduce the probabilities and consequences of transportation accidents. Credible accidents associated with the proposed destruction facility and initiated by human error would not play a major role in the overall risk of destruction operations due to the estimated downwind no-deaths distances of these accidents with respect to the distance from the site of the proposed destruction facility to the nearest PCD boundary.

4.26.3 Emergency Preparedness

Effective emergency planning and management through the Chemical Stockpile Emergency Planning Program could mitigate the consequences of accidental chemical agent releases for the population living near PCD. Emergency planning and response capabilities have been upgraded in the PCD vicinity, with Army assistance; consequently, emergency planning and preparedness would mitigate impacts from accidents during continued storage (no action), as well as from accidents during operation of the proposed destruction facility. The proposed action of on-site destruction under any of the four technology alternatives would have little, if any, impact on the planning and implementation of upgrades. The emergency response program for PCD under the proposed action of chemical munitions destruction would resemble that under no action. The upgrades to emergency preparedness and response comprise a beneficial impact of the proposed action.

4.26.4 On-Site Medical Support

A medical facility with the latest supplies and equipment for diagnosing and treating occupational illnesses and injuries and for treating and decontaminating chemical casualties would be located on-site. This medical facility would have sufficient beds to support the most probable event (MPE). The MPE is the worst potential mishap most likely to occur during routine handling, storage, maintenance, surveillance, or demilitarization operations that could result in the release of agent and personnel exposure. The medical facilities would be government-owned but operated by contract medical personnel in accordance with applicable Department of the Army and Joint Commission on Accreditation of Health Care Organizations publications.

4.26.5 Monitoring

The ability to detect very small quantities of agents HD and HT (agent monitoring) is crucial to assuring the continued health and safety of PCD workers and the public.

4.26.5.1 Agent monitoring

Standards and procedures for monitoring mustard agent are summarized in this section.

4.26.5.2 Standards for agent exposure

The U.S. Department of Defense (DOD) airborne exposure limits for the agents of interest are presented in Table 4.17. These safety standards have been established by DOD—and in some cases DHHS to serve as guidelines for monitoring within the chemical demilitarization plant, within the storage areas, during transport activities, and on the perimeter of the installation. The airborne exposure limits are set conservatively to provide an adequate safety margin to protect workers and public health. The exposure limits (see Table 4.17) are defined as follows:

- *Time-weighted average (TWA)*. The TWA is the allowable unmasked worker exposure limit established by the Army and approved by DHHS for an 8-hr/day exposure averaged throughout a maximum of five consecutive work periods for an indefinite time.
- *General population limit (GPL)*. The GPL is the allowable TWA agent exposure limit established for the general public for a 72-hr time period.
- *Source emission limit (SEL)*. The SEL is the maximum allowable concentration of agent that can be emitted at the stack. Emissions meeting the SEL should be (1) avoided by a well-designed, -constructed, and -operated incineration facility; (2) an early indication of process fluctuations; and (3) measurable in an accurate and timely manner. Air dispersion modeling has demonstrated that the allowable GPL and TWA limits would not be exceeded as a consequence of emissions at SEL.
- *Immediately Dangerous to Life and Health (IDLH*). The maximum concentration from which, in the event of respirator failure, one could escape within 30 min without a respirator and without experiencing any escape impairing (e.g., severe eye irritation) or irreversible health effects. These values were determined during the Standards Completion Program only for the purpose of respirator selection (i.e., the requirement for wearing of self-contained breathing apparatus or supplied air respirator protective devices).
- *Gross Level Detector (GLD)*. An engineered control level for mustard that has been established for exiting airlocks and specified locations within agent contaminated areas. The level assigned is 0.2 mg/m^3. This level is consistent with the hardware and software of ACAMS and is below the 1.67 mg/m^3 which correlates to the regulatory basis for IDLH values for other agents. An IDLH has not been assigned by regulation for mustard because of its carcinogenic properties.
- *Maximum permissible limit for demilitarization protective ensemble (MPL)*. An engineering control level based on the maximum concentration in which personnel in DPE may work for two or less hours per entry in agent contaminated areas. The agent concentration and time limit on DPE entries at this engineering control level was based on the maximum agent concentration used in DPE penetration testing.

4.26.5.3 Instrumentation

Air monitors currently in use and available for the facility include rapid-response detectors and delayed-response samplers. Air monitors for mustard are well developed and have been subjected to extensive certification testing in actual monitoring environments. Monitoring systems would include an automatic continuous air monitoring system (ACAMS) and a depot area air monitoring system (DAAMS), each of which can detect low and high levels of agent. ACAMS primarily produces audible alarms in the presence of high or low levels of agent, whereas DAAMS provides a continuous record of low as well as high agent levels.

ACAMS is an automated gas chromatograph that can be configured to detect mustard at TWA, SEL, IDLH, GLD, or MPL agent levels. The chromatogram is recorded on a strip chart, and an alarm is provided that would be wired to a remote control center, as required. The response times for ACAMS range from 2 to 5 min.

DAAMS consist of a solid sorbent tube through which air is aspirated for a predetermined period of time. Samplers are used to obtain time-dependent average concentrations at low detection levels for historical documentation. Gas chromatography is employed because it is the only method with the sensitivity to detect low levels represented by GPL. Sampling times are about 1, 2, and 12 hr for SEL, TWA, and GPL respectively.

Sampling for the presence of high levels of mustard during routine surveillance activities can be performed with chemical agent field detector kits. These kits can include a hand-operated aspirator bulb, detector tubes, detector paper, and reagents. Air is drawn through a detector tube, and when the tube has been treated with reagent solution, an immediate color change is observed if agent vapor is present. For liquid sampling, the detector paper is put in direct contact with the unknown liquid. A specific and immediate color change is used to confirm the presence of agent.

4.26.5.4 Storage monitoring

Monitoring is performed to detect chemical agent leakage from defective chemical weapons. Most leaks are vapor leaks from pin-sized holes, although liquid leaks from weld cracks or serious corrosion penetrations are also detected. Monitoring results are used to define the level of protective equipment needed and to verify the safety of workers performing surveillance and maintenance. Procedures to monitor storage areas have been implemented and validated during the past several decades.

4.26.5.5 Handling and on-site transport monitoring

Before any igloos would be opened for transferring the munitions, monitoring would be performed in accordance with site-specific safety plans. The workers would then remove munitions from the igloo or storage area, load them into transport containers, and check the integrity of the seals.

4.26.5.6 Destruction plant monitoring

A network of chemical agent alarms and samplers would be used in the demilitarization plants

1. to verify compliance with applicable work area and stack-emission standards,
2. to detect process fluctuations so that corrective actions could be taken before a hazardous situation could develop, and
3. to verify the safety of the operation.

The instruments that would be used include ACAMS and DAAMS. The ACAMS would serve as the chemical agent alarms, notifying plant operators of process fluctuations as well as potentially hazardous conditions. DAAMS would be used to provide a historical record of agent concentrations and to confirm ACAMS alarms.

If agent were detected, ACAMS would provide a local alarm, and a signal would be transmitted from most stations to activate a visible and audible alarm in the control room. Stations used at airlocks and some other areas are not usually linked to the control room since agent may be present there as part of normal operations. The local alarm would alert outside operators to wear their protective masks and take proper action as outlined in the Army protocol. A permanent record of the date, time, and location of any linked alarm would be recorded automatically on a computer.

4.26.6 Perimeter Monitoring

The purpose of the perimeter monitoring stations would be to provide a historical record of any potential major agent release. The monitoring system is not intended to control destruction activities nor to provide an early warning of an accidental release. This kind of information has been used in the past to prove the historical safety of destruction operations. The destruction facility ventilation system and furnace stacks would be monitored for agent continuously to provide early warning signs of an accidental release.

Current plans are to install the perimeter monitoring stations at PCD prior to the commencement of destruction operations such that adequate baseline monitoring can be completed. The number and location of these stations are being considered. The Army Center for Health Promotion and Preventive Medicine, which has been involved in developing or reviewing the perimeter monitoring systems at DCD and JACADS, has been asked to initiate a study that reviews site specific characteristics and to provide a recommendation on the number and location of these monitoring stations at PCD. The perimeter monitoring plan would be coordinated with CDPHE and DHHS prior to finalization.

4.26.7 Ecological Mitigation

The following measures would minimize impacts from construction and operations on all ecological resources:

- Avoid siting PMCD facilities in the southern portion of Area C and the western portion of Area B to minimize impacts to black-tailed prairie dog colonies.
- Plan construction in Area A to avoid sensitive northern sandhill prairie plant communities along the north and northeast perimeter of Munitions Storage Area A.
- Conduct clearance surveys for mountain plovers in shortgrass prairie before construction. Follow guidelines developed by the USFWS.
- Conduct clearance surveys for federal and state protected species in areas expected to be disturbed at the facility site, along new access roads, and along infrastructure corridors.

- Avoid adverse effects on wetlands by appropriate siting and the use of best management practices and/or engineering practices in construction of running routes and utility corridors.
- Require construction forepersons and equipment operators to be briefed on sensitive ecological resources and mitigation practices before the start of construction.
- Limit vehicle speed along site access roads to reduce the incidence of road kills.
- Provide periodic openings, if feasible, in all fencing constructed to form an exclusion zone beyond the facility boundary fence to allow pronghorn antelope to pass.
- Revegetate disturbed areas along infrastructure rights-of-way and the construction site with native seed/shrub mixes recommended by the Natural Resources Conservation Service.
- In addition, revegetate with shortgrass prairie plant species to benefit the following wildlife species of concern to the Colorado Division of Wildlife: mountain plover, burrowing owl, swift fox, and black-tailed prairie dog (Kaczmarek 2000).
- Monitor the AWS ponds and potentially affected wetlands for water levels and health of the resident southern red-bellied dace population and the plains and northern leopard frog populations. Should these parameters show significant reductions, develop a plan to augment the water supply to the pond and/or wetlands by artificial means if necessary.

4.27 PERMITTING

Before implementing the proposed action, the Army would be required to coordinate its actions with various federal, state of Colorado, and local legal and regulatory authorities. This section summarizes the permits, approvals, and consultations required by these authorities.

4.27.1 Permits and Approvals Required for Construction

Certain reviews, permits, and approvals must be obtained before construction. According to Public Law 91-121 (Armed Forces Appropriations Act of 1970) and Public Law 91-441 (Armed Forces Appropriations Act of 1971), any destruction plan that the Army prepares must be reviewed by DHHS, whose supervisory responsibility and authority are normally thought of in terms of its public health and safety functions; DHHS also looks critically at the potential impacts of proposed projects.

Executive Order 12088, *Federal Compliance with Pollution Control Standards*, and other public laws require that all federal agencies comply with all applicable federal, state, and local pollution control standards. Compliance with applicable pollution control standards requires that the Army secure environmental permits in the same manner as do private project sponsors. Department of Army Regulation 200-1 requires that all major permits and approvals for an activity be secured before any construction is begun. A RCRA permit application for the proposed facility will be submitted to the state of Colorado and applications for air emissions source permits will be submitted to the state of Colorado after issuance of the ROD in accordance with the requirements of the Clean Air Act and state of Colorado and local air quality regulations.

Prior to beginning construction of an incinerator, the Army is required to submit an application to Pueblo County for a Certificate of Designation, which requires the completion of an agricultural assessment.

The processes for acquiring the RCRA and air permits are very similar, but their technical contents are quite different. The Army submits draft permit applications to the state of Colorado and responds to notices of deficiencies. The state then proposes specific permit terms. At that point, the permits are made available for review and comment by the permittee (the Army) and the public. After reviewing the comments, the state issues the final permits, and construction may begin.

Letters from FWS in regard to potential impacts to threatened and endangered species, and from the Colorado State Historic Preservation Officer in regard to potential impacts to historic or archaeologic resources, are presented in Appendix F.

4.27.2 Permits and Approvals Required for Operation

After completing construction, the Army would test the destruction facility. Initial tests would be conducted with agent surrogates; then actual trial burns would be conducted with agent. Results of the test burns would be submitted to the state of Colorado and federal agencies. If the test burn results were acceptable, the state of Colorado would impose final RCRA operating conditions as necessary. As long as operation of the destruction facility continued, the Army would be subject to a variety of reporting, inspection, notification, and other permit requirements of the state of Colorado. DHHS would continue its supervisory role, reviewing data and making appropriate recommendations concerning public health and safety before toxic operations begin. No NPDES permits, other than for sanitary sewage, would be required.

4.28 REFERENCES

ACE (US Army Corps of Engineers). 1998. *Analysis of BMPs for Small Construction Sites.* Prepared for EPA Office of Wastewater Management.

AEPI (Army Environmental Policy Institute) 2000. *Economic Impacts Forecast System Summary*, Atlanta, Georgia, October 24.

ANL (Argonne National Laboratory) 2001a. *Draft Environmental Impact Statement: Design, Construction and Operation of One or More Pilot Test Facilities for Assembled Chemical Weapons Destruction technologies at One or More Sites*, Program Manager for Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md.

ANL (Argonne National Laboratory) 2001b. Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement. Volume 4: Assembled Systems for Weapons Destruction at Pueblo Chemical Depot, Program Manger for Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md.

APCD (Air Pollution Control Division) 2001. Colorado Modeling Guidance for Air Quality Permits. <http://apcd.state.co.us/permits/giude.html> accessed September 21, 2001.

A. T. Kearney, Inc. 1996. *Tooele Chemical Demilitarization Facility, Tooele Army Depot South, EPA I.D. No. UT5210090002, Screening Risk Assessment*, for State of Utah Department of Environmental Quality, Division of Solid and Hazardous Waste, Salt Lake City, Utah.

Avian Power Line Interaction Committee 1996. *Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996.* Edison Electric Institute/Raptor Research Foundation, Washington, D.C.

Benjamin and Geomatrix 1996. *Probabilistic Seismic Hazard Assessment for the U.S. Army Chemical Disposal Facility, Pueblo Depot Activity, Colorado,* JBA 148-130-PU-002, Rev. 0, prepared by Jack R. Benjamin and Associates, Inc., and Geomatrix Consultants, Mountain View, California, March.

Black, J. M. 2002. Memorandum from Joan M. Black, SAIC, to Tim Ensminger, ORNL, January 10.

Brattstrom, B.H., and M.C. Bondello 1983. Effects of Off-Road Vehicles on Desert Vertebrates. pp. 167-206 in Webb, R.H., and H.G. Wilshore (editors). *Environmental Effects of Off-Road Vehicles: Impacts and Management in Arid Regions*. Springer Verlag, New York, N.Y.

Buswell, A. M. et al. 1944. *The Effects of Certain Chemical Warfare Agents in Water on Aquatic Organisms*. National Defense Research Committee, Office of Scientific Research and Development, OSRD No. 3589.

Cain, K. 1999. Re-application for the National Pollutant Discharge Elimination Permit Number CO-0034673 for Pueblo Chemical Depot, EPA ID FC08213820725, U.S. Environmental Protection Agency, Region VIII, March.

Canestorp, K. M. 2000, letter from Canestorp (U.S. Fish and Wildlife Service, Pueblo Chemical Depot, Pueblo, Colo.) To E. D. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 1.

Canestorp, K. M. 2001. Pueblo Chemical Depot Integrated Natural Resources Management Plan FY01 through FY05, prepared by K. M. Canestorp, U.S. Fish and Wildlife Service, for the U.S. Department of the Army Pueblo Chemical Depot, Pueblo, Colorado, January 4.

Canter, L. W. 1975. *Environmental Impact Assessment*. McGraw_Hill Book Company, New York.

Carlson, L. W. 2000, letter from Carlson (U.S. Department of Interior, Fish and Wildlife Service, Colorado Field Office, Lakewood, Colo.) To E. D. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 9.

Carter, W.P.L. 1994. Development of Ozone Reactivity Scales for Volatile Organic Compounds, *J. Air and Waste Management Assoc.* 44, 881-899.

CDPHE (Colorado Department Of Public Health & Environment). 1996. Guidance Document: Light And Heavy Industry Permits - Preparing A Stormwater Management Plan. Water Quality Control Division.

CDPHE (Colorado Department of Public Health and Environment), 1997. PCD Compliance Order on Consent Number 97-07-15-01.

CDPHE (Colorado Department of Public Health and Environment) 2000. *Colorado Ambient Air Quality Standards* (I. A), Air Quality Control Commission.

CDPHE (Colorado Department of Public Health and Environment) 2000a. *Colorado air Quality Commission report to the Public 1999-2000,* Air Pollution Control Division, Denver.

CDPHE (Colorado Department of Public Health and Environment) 2000b. Memorandum from Nanch Chick, CDPHE, to T. J. Blasing, Oak Ridge National Laboratory, September 27, 2000.

CDPHE (Colorado Department of Public Health and Environment) 2001. Memorandum from Nanch Chick, CDPHE, to T. J. Blasing, Oak Ridge National Laboratory, March 1, 2001.

Chafin, D. T. 1996. *Hydrogeology of the Alluvial Aquifers at the Pueblo Depot Activity Near Pueblo, Colorado*, Water-Resources Investigations Report 95-4137, U.S. Geological Survey, Denver, Colorado.

City of Pueblo 1999. *1997–1998 City of Pueblo Comprehensive Annual Financial Report.* Pueblo, Colorado.

City of Pueblo 2000. *Pueblo Data Book On-Line*. Prepared by the City of Pueblo Planning Department. http://www.ci.pueblo.co.us/databook.

Colorado School District 60 1999. *FY 1997–1998 Annual Report for the Colorado Department of Education.* Pueblo, Colorado.

Colorado School District 70 1999. *FY 1997–1998 Annual Report for the Colorado Department of Education.* Pueblo, Colorado.

CNHP (Colorado Natural Heritage Program) 1999. Conservation Status Handbook, Colorado's Animals, Plants, and Plant Communities of Special Concern. Vol. 3, No. 2. Colorado State University, Fort Collins, Colorado, and The Nature Conservancy.

Ebasco Environmental 1990. *Enhanced Preliminary Assessment Report: Pueblo Depot Activity Pueblo, Colorado*, prepared by Ebasco Environmental, Lakewood, Colorado, under the supervision of the Environmental Assessment Division, Argonne National Laboratory, Argonne, Ill., for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland.

Ecology and Environment, Inc. 1996. *Draft Pre-Trial Burn Risk Assessment for the Proposed Umatilla Chemical Demilitarization Facility, Hermiston, Oregon*, Seattle, Wash., for Oregon Department of Environmental Quality, Bend, Oregon.

EDAW et al. 1994. *Pueblo Depot Activity Reuse Development Plan.* Prepared by EDAW, Inc.; Hammer, Siler, George; and Wilson & Company for the Pueblo Area Council of Governments and the U.S. Department of Defense, Office of Economic Adjustment.

EG&G Defense Materials, Inc. 1997. "Site noise survey for Environmental Impact Statement," Memo from J. P. Maddox, EG&G, to Janice D. Wards, U.S. Army Industrial Operations Command, Tooele, UT, Oct 7.

Emlen, J.T. 1971. Population densities of birds derived from transect counts. The Auk 88 : 323-342.

EPA (U.S. Environmental Protection Agency) 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. EPA 550/9-74-004. Office of Noise Abatement and Control, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1978. *Protective Noise Levels: Condensed Version of the EPA Levels Document*, EPA-550/9-79-100, U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1985. *Compilation of Air Pollutant Emission Factors*, Vol. I: Stationary Point and Area Sources, 4th ed. EPA Publication AP-42, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

EPA (U.S. Environmental Protection Agency) 1988. *Gap Filling PM-10 Emission Factors for Selected Open Area Dust Sources*, EPA-450/4-88-003, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

EPA. 1992d. Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices. EPA 832-R-92-005. Washington, DC.

EPA. 1992e. Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices. EPA 832-R-92-006. Washington, DC.

EPA. 1993a. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA 840-B-92-002. Washington, DC.

EPA (U.S. Environmental Protection Agency) 1995. *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models*, EPA-454/B-95-003, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

EPA. 1996a. Protecting Natural Wetlands: A Guide to Stormwater Best Management Practices. EPA-843-B-96-001. Washington, DC.

EPA (U.S. Environmental Protection Agency) 2000. *RCRIS National Oversight Database*, *Hazardous Waste Treatment, Storage and Disposal Facilities*, Office of Solid Wastes, Apr. 20, URL: http://www.epa.gov/epaoswer/hazwaste/data/tsd/tsdregst.zip, accessed August 29, 2000.

EPA (U.S. Environmental Protection Agency) 2000. *One-hour Smog Standard Reinstated to Protect Public Health*, Headquarters Press Release, July 6.

EPA (U.S. Environmental Protection Agency) 2001. Colorado NET (National Emissions Trends) Air Pollution Point Sources for Criteria Pollutants (for Pueblo County) (http://www.epa.gov.airsdata.net.htm). Accessed February 14, 2001.

EPA (U.S. Environmental Protection Agency) 2001. *Dioxin Reassessment*, (http://www.epa.gov.ncea/pdfs/dioxin/dioxreass.htm). Accessed February 10, 2001.

EPA (U.S. Environmental Protection Agency) 2001. *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*, (http://www.epa.gov/ttn/chief/ap42). Accessed February 24, 2001.

FEC (Foothills Engineering Consultants, Inc.) 1998. *Cultural Resources Survey of the Pueblo Chemical Depot, Pueblo County, Colorado.* Vols. I–III. Prepared for the U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska.

Federal Register (FR 64,189, Sept 30, 1999. Environmental Protection Agency 40 CFR Part 60 et al. NESHPS: Final Standards for Hazardous Air Pollutants for Hazardous Waste Combustors, Final Rule.

FWS (U.S. Fish and Wildlife Service) 1999. *National Wetlands Inventory Map: North Avondale*, Colorado Quadrangle. U.S. Department of the Interior.

Fitzgerald, J.P., et al. 1994. *Mammals of Colorado*. Denver Museum of Natural History and University Press of Colorado. Denver, Colorado.

GA Technologies, Inc. 1987. *Risk Analysis of the On-Site Disposal of Chemical Munitions*, GAC-18562 and SAPEO-CDE-IS-87010, GA Technologies, Inc., La Jolla, California.

Graedel, T. E., and P. J. Crutzen 1993. *Atmospheric Change: An Earth System Perspective*, W.H. Freeman and Co., New York.

Hammerson, G.A. 1999. *Amphibians and Reptiles in Colorado.* Colorado Department of Natural Resources, Division of Wildlife. Denver, Colorado.

JACADS 1999. *JACADS Metal Parts Furnace, 4.2-inch HD Mortar Projectiles Trial Burn Report*, Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., August.

Kaczmarek, K., 2000, letter from Kaczmarek (Colorado Department of Natural Resources, Division of Wildlife, Denver, Colo.) to E. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 26.

Kimmell, T., S. Folga, G. Frey, J. Molberg, P. Kier, B. Templin, M. Goldberg. 2001. Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement, Vol. 4. ANL/EAD/TM-101, Environmental Assessment Division, Argonne National Laboratory, May 2001.

Kingery, H.E. (editor). 1998. Colorado Breeding Bird Atlas. Published by Colorado Bird Atlas Partnership and Colorado Division of Wildlife. Denver, Colorado.

Kirkham, R. M. and W. P. Rogers 1981. *Soil Survey of Pueblo Area, Colorado, Parts of pueblo and Custer Counties*, Soil Conservation Service.

Knopf, F.L. 1996. Perspectives on Grazing Non-Game Bird Habitats. In Rangeland Wildlife (R.R. Krausman, editor) Society for Range Management, Denver, Colo.

Kornelly and Associates/KPMG Inc. 1999. *Economic Impact Study for the Pueblo Chemical Depot Chemical Demilitarization Facility*. Pueblo, Colorado.

Larson, T. K., and D. M. Penny 1995. *Results of a Class III Pedestrian Survey on Portions of the Pueblo Depot Activity Area, Pueblo County, Colorado*. Vols. I and II. Prepared by Gulf Engineers & Consultants, Inc., Baton Rouge, Louisiana, and Larson-Tibesar Associates, Inc., Laramie, Wyoming, for the U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska.

Liebich, R.E., and M.P. Cristoforo, 1988, *The Use of Audibility Analysis to Minimize Community Noise Impact of Today's Smaller Generation Facilities Located near Residential Areas*, presented at American Power Conference 50th Annual Meeting, Chicago, Ill.

Luz, G.A., and J. B. Smith. 1976. Reactions of Pronghorn Antelope to Helicopter Overflight. J. Acoust. Soc. Am. 59 : 1514-1515.

MacDonald and Mack Partnership 1984. *Historic Properties Report, Pueblo Depot Activity, Pueblo, Colorado.* Minneapolis, Minnesota.

Manci, K. M. et al. 1988. Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife. AFESC TR 88-14, NERC-88/29. U.S. Air Force, Engineering and Service Center and U.S. Fish and Wildlife Service, Fort Collins, Colo.

Marrero, P. 2000. Telephone communication between Marrero (Pueblo Chemical Depot) and T. Allison (Argonne National Laboratory). January.

Mitretek 2000. *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons at the U.S. Army's Pueblo Chemical Depot using the Parsons/Honeywell Neutralization/Biotreatment Technology or the General Atomics Neutralization/Supercritical Water Oxidation Technology*, McLean, Va., May 10. [We need to obtain a copy of this document.]

Montgomery, J. 1984. *An Archaeological Overview and Management Plan for the Pueblo Depot Activity, Pueblo County, Colorado.* Nickens and Associates, Montrose, Colorado.

MIG, Inc. 2000. *IMPLAN Data Files*. Stillwater, Minnesota.

MSE Technology Applications, Inc. 2000. *Controlled Emissions Demonstration Project Final Report—Activated Carbon Mercuric-Chloride Removal Volume I*, PTP-76, prepared for the U.S. Department of Energy, National Energy Technology Laboratory, Penn., Sept.

Munro, N. B, et al. 1999. The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products. Environmental Health Perspectives 107(12). December.

NOAA (National Oceanic and Atmospheric Administration), 1999, *Local Climatological Data: Annual Summary with Comparative Data for Pueblo, Colorado*, National Climatic Data Center, Asheville, N.C.

NSC (National Safety Council) 1999. *Injury Facts*, National Safety Council, Itasca, IL.

Oburn, D. 2000. Telephone communication between Oburn (Pueblo Chemical Depot) and T. Allison (Argonne National Laboratory). January.

Parker, P. 1993. *Traditional Cultural Properties: What You Do and How We Think.* Special issue of *Cultural Resources Management*, Vol. 16.

PDADA (Pueblo Depot Activity Development Authority) 2000a. *Pueblo Chemical Depot Reuse Development Plan Update*. June.

PDADA 2000b. *Pueblo Depot Activity Development Authority 1999 Annual Report*. April.

PDADA 2001. Comments on the *Destruction of Chemical Munitions at Pueblo Chemical Depot, Colorado, Draft Environmental Impact Statement.* Letter from Charles J. Finley, Executive Director, PDADA, to Gregory Mahall, Public Outreach and Information Office, PMCD. June 7.

Pentecost, E. 2000a. Letter from E. Pentecost (Argonne National Laboratory, Argonne, Ill.) to L. Carlson (Colorado Ecological Field Services Office, U.S. Fish and Wildlife Service) April 24.

Pentecost, E. 2000b. Letter from E. Pentecost (Argonne National Laboratory, Argonne, Ill.) to J. Mumma (Colorado Department of Natural Resources, Division of Wildlife, Denver, Colo.) April 24.

Pueblo County 1999a. *Pueblo Chemical Depot Demilitarization Facility Economic Impact Study*. October.

Pueblo County 1999b. *1997–1998 Pueblo County Comprehensive Annual Financial Report.* Pueblo, Colorado.

PUDA (Pueblo Depot Activity) 1995. *Application for Air Pollution Emission Permit for the Department of the Army Pueblo Depot Activity Chemical Agent Disposal Facility*, Submitted to the Colorado Department of Public Health and Environment, Air Pollution Control Division, Denver, Colorado (September).

Rhodes, M., 2000, electronic data transmittal from Rhodes (Decision and Information Sciences Division, Argonne National Laboratory, Urbana, Ill.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Jan. 5.

Rink, B. 2000, Electronic data transmittal from Rink (Colorado Department of Public Health and Environment, Denver Colorado) to Y.-S. Chang (Argonne National Laboratory, Argonne, IL), February 3.

Robbins, C. S. et al. 1966. Birds of North America. Golden Press, New York, N.Y.

Rust. 1999. Ecological Survey Report for Pueblo Chemical Depot. Pueblo, Colo.

Rust and E-E Management. 1996. Ecological Surveys at Pueblo Chemical Depot Pueblo, Colorado, Vol. 1. Prepared by Rust Environmental and Infrastructure, Inc., Englewood, Colo., and Engineering Environmental Management, Inc., Lakewood, Colo. For U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., June.

Rust Environment and Infrastructure, Inc., 1997. Draft Final Preliminary Groundwater Evaluation Report, Pueblo Chemical Depot, Pueblo, Colorado, December.

SAB (Science Advisory Board) 1995. *Re-evaluating Dioxin, Science Advisory Board's Review of EPA's Reassessment of Dioxin and Dioxin-like Compounds*, EPS-SAB-EC-95-021, U.S. Environmental Protection Agency, Washington, D.C.

Scott, G. R., et al. 1978. *Geologic Map of the Pueblo 1° × 2° Quadrangle, South-Central Colorado,* Miscellaneous Investigations Map I-1022, U.S. Geological Survey, Denver, Colorado.

Shah, H. H. and J. W. Reed 1996. *Seismic Fragilities of Structures and Equipment U.S. Army Pueblo Chemical Agent Disposal Facility Pueblo, Colorado,* Jack R. Benjamin and Associates, Inc., Mountain View, California, March.

Simmons, T. H., and R. L. Simmons 1998. *Historic Structures Survey, Pueblo Chemical Depot, Pueblo County, Colorado.* Prepared by Front Range Research Associates, Inc., Denver, Colorado, for Foothills Engineering Consultants, Inc.

Smith, K. 2000. Telephone communication between Smith (Pueblo County Department of Transportation) and T. Allison (Argonne National Laboratory). January 24.

Storm Prediction Center, 2000, *Historical Tornado Data Archive* [http://www.spc.noaa.gov/archive/tornadoes/index.html].

Tinney, R. 2000. Telephone communication between Tinney (Colorado Department of Transportation and T. Allison (Argonne National Laboratory). January 24.

Transportation Research Board 1985. *Highway Capacity Manual.* National Research Council, Washington D.C.

UEC (United Engineers and Constructors) 1992. *RCRA Trial Burn Report for HD-Mustard Ton Containers - Metal Parts Furnace at the Johnston Atoll Chemical Agent Disposal System,* prepared for the Program Manager for Chemical Demilitarization, by United Engineers and Constructors, Philadelphia, PA.

UEC (United Engineers and Constructors) 1993. *Results of the Demonstration Test Burn for Thermal Destruction of Agent HD in the Johnston Atoll Chemical Agent Disposal System Liquid Incinerator*, prepared for the Program Manager for Chemical Demilitarization, by United Engineers and Constructors, Philadelphia, PA, (February).

USACHPPM (U.S. Army Center for Health Promotion and Preventative Medicine) 1996. *Final Screening Risk Assessment: Anniston Chemical Agent Disposal Facility*, Risk Assessment No. 39-26-1399-95, Anniston Army Depot, Anniston, Alabama.

USACHPPM (U.S. Army Center for Health Promotion and Preventative Medicine) 1997. *Environmental Impact Risk Assessment in Support of the NEPA Process for the Pine Bluff Chemical Agent Disposal Facility, Pine Bluff Arsenal, Arkansas*, Report No. 39-26-6683-97, prepared for Program Manager for Chemical Demilitarization by USACHPPM, Aberdeen Proving Ground, Md., April.

USACHPPM (U. S. Army Center for Health Promotion and Preventative Medicine) 1999. Development and Derivation of Inhalation Benchmark Values for Wildlife: An Application to Identify Ecological Risk to Airborne Contaminants, Health Effects Research Study. 87 1299-99, Anniston, Ala., December.

USACOE (U.S. Corp of Engineers) 1987. Wetland Delineation Manual. Technical Report Y-87-1. Waterways Experiment Station. Vicksburg, MS.

USAEHA (U.S. Army Environmental Hygiene Agency) 1990. *Environmental Noise Study No. 52-34-0490-90, Pueblo Army Depot Activity, Pueblo, Colorado, 11-15 September 1989*. U.S. Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland.

USAEHA (U.S. Army Environmental Hygiene Agency) 1992. *Inhalation Risk from Incinerator Combustion Products, Operational Verification Testing-Phase I, Johnston Atoll Chemical Agent Disposal System, Health Risk Assessment No. 42-21-MQ49-92,* U.S. Army Chemical Materiel Destruction Agency, SFIL-CME, Aberdeen Proving Ground, MD.

USAEHA (U.S. Army Environmental Hygiene Agency) 1993. *Inhalation Risk Posed from Incinerator Combustion Products, Operational Verification Testing – Phase 3, Johnston Atoll Chemical Agency Disposal System*, Health Risk Assessment No. 42-21-M1X6-93, U.S. Army Materiel Destruction Agency, Aberdeen Proving Ground, Md.

USATHAMA (U.S. Army Toxic and Hazardous Materials Agency) 1990. *Enhanced Preliminary Assessment Report: Pueblo Depot Activity, Pueblo, Colorado*, CETHA-BC-CR-90045, Aberdeen Proving Ground, Md.

U.S. Army 1984. *Installation Environmental Assessment, Pueblo Depot Activity, Pueblo, Colorado.* Headquarters, U.S. Army Depot System Command, Tooele, Utah.

U.S. Army 1987. *Chemical Stockpile Disposal Program: Roads and Utilities Project Development Brochure, Pueblo Depot Activity (PUDA).* U.S. Army Corps of Engineers, Huntsville Division. December.

U.S. Army et al. 1987. *Geological-Seismological Investigation of Earthquake Hazards for a Chemical Stockpile Disposal Facility at the Pueblo Depot Activity, Colorado*, prepared by the U.S. Army Engineer Division, Huntsville, Alabama; Jacobs Engineering Group, Inc., and URS/John A. Blue & Associates, Engineers, for the Office of the Program Manager for Chemical Munitions.

U.S. Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1-3, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

U.S. Army et al. 1992. *Seismic Design for Buildings,* Army Technical Memorandum (TM) 5-809-10, Headquarters, Departments of the Army, Navy, and Air Force, Washington, D.C.

U. S. Army 1996. *Pueblo Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment*, prepared by Science Applications International Corporation for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., November.

U.S. Army et al. 1997. *Programmatic Agreement among the United States Army, the Colorado State Historic Preservation Officer, and the Advisory Council on Historic Preservation for the Utilization and Eventual Disposal of Above Ground Facilities at Pueblo Chemical Depot, Colorado*.

U.S. Army 1997. *Environmental Assessment: Reuse of a Portion of Pueblo Chemical Depot, Colorado.* U.S. Army Materiel Command, Alexandria, Virginia.

U.S. Army 2000a. *Biennial Hazardous Waste Report for Pueblo Chemical Depot (PCD)*, prepared for Colorado Department of Public Health, Hazardous Materials and Waste Management Division, Denver, Colo. [We need to obtain a copy of this document.]

U.S. Army 2000b. *Pueblo Modified Baseline Technology: Input for the Environmental Impact Statement Analysis*. Program Manager for Chemical Demilitarization. June.

U.S. Army 2001, *MACT Rule: Impact Assessment & Programmatic Compliance Strategy, Rev 2,* February 2001.

U.S. Bureau of the Census 1992a. *1990 Census of Population and Housing, Summary of Social, Economic, and Housing Characteristics, Colorado.* 1990 CPH-5-7, Washington, D.C.

U.S. Bureau of the Census 1992b. *1990 Census of Population and Housing, Summary Tape File 3a.* [http://www.ciesin.org] Data recompiled and presented by CIESIN, Inc., New York, New York.

U.S. Bureau of the Census 1992c. *1990 Census of Population and Housing, Summary Tape File 3a.* Data recompiled and presented by ESRI, Inc., Redlands, California.

U.S. Bureau of the Census 1992d. *County Business Patterns, 1990*. Washington, D.C.

U.S. Bureau of the Census 1994.*City and County Data Book*. Washington, D.C.

U.S. Bureau of the Census 1999a. *Estimates of the Population of Places*. Washington, D.C.

U.S. Bureau of the Census 1999b. *County Population Estimates*. Washington, D.C.

U.S. Bureau of the Census 1999c. *County Business Patterns, 1997.* Washington, D.C.

U.S. Bureau of Labor Statistics 2000. *Local Area Unemployment Statistics.* Washington, D.C.

U.S. Department of Agriculture 1999a. *Census of Agriculture—County Data, 1992*. National Agricultural Statistics Service, Washington, D.C.

U.S. Department of Agriculture 1999b. *Census of Agriculture—County Data, 1997*. National Agricultural Statistics Service, Washington, D.C.

U.S. Department of Commerce 1968. *Climatic Atlas of the United States*, Environmental Science Services Administration, Environmental Data Service, Washington, D.C. 80 pp.

U.S. Department of Health and Human Services 1992. *Toxicological Profile for Mustard "Gas."* TP 91/92. Agency for Toxic Substances and Disease Registry. U.S. Public Health Service, Washington, D.C.

U.S. Supreme Court 2001. Christine Todd Whitman, Administrator of Environmental Protection Agency, et. Al., v American Trucking Associations, et. Al, Nos. 99-1257 and 99-1426, Decided February 27, 2001.

Venkatadri, R. 2001. Memorandum from Rajagopalan Venkatadri, SAIC, to Tae Park, Amy Dean, and Penny Robitaille, SBCCOM, December 7.

Watts, K. R., and R. F. Ortiz 1990. *Geohydrology and Ground-water Quality at Pueblo Depot Landfill near Pueblo, Colorado*, U.S. Geological Survey, Denver, Colorado.

Whitacre, G. C., et al. 1986. Personal Computer Program for Chemical Hazard Prediction (D2PC). U.S. Army Chemical Research and Development Center. Aberdeen Proving Ground, Md.

Zoellick, B. W., and N.S. Smith. 1992. Size and spatial organization of home ranges of kit foxes in Arizona. J. Mammal 73 (1): 83-88.

5. LIST OF PREPARERS

T. J. Blasing, Oak Ridge National Laboratory, Oak Ridge, Tenn.; Ph.D., Meteorology, University of Wisconsin–Madison; M.S., Meteorology, University of Wisconsin–Madison; B.S., Meteorology, University of Wisconsin–Madison; 23 years experience in environmental assessment. Contribution: meteorology, air quality, and noise.

C. E. Easterly, Oak Ridge National Laboratory, Oak Ridge, Tenn.; Ph.D. Health Physics, University of Tennessee; B.S. Physics, Mississippi State University; 27 years in environmental impact assessment. Contribution: human health.

J. T. Ensminger, Oak Ridge National Laboratory, Oak Ridge, Tenn.; M.S., Biology, East Tennessee State University; B.S., Environmental health Sciences, East Tennessee State University; 20 years experience in environmental assessment. Contribution: project management.

C. B. Foust, Oak Ridge National Laboratory, Oak Ridge, Tenn.; MPH, Environmental and Occupational Health and Safety, University of Tennessee; B.S., Health, Lee University; 10 years experience in environmental assessment. Contribution: human health.

G. K. Eddlemon, Oak Ridge National Laboratory, Oak Ridge, Tenn.; M.S., Zoology, University of Tennessee; B.S., Zoology, University of Tennessee; 23 years experience in environmental impact assessment. Contribution: aquatic ecology and threatened and endangered species.

C. W. Hagan, Jr., Oak Ridge National Laboratory, Oak Ridge, Tenn.; M.A., English Language and Literature, Virginia Polytechnic Institute and State University; B.A., English, Virginia Polytechnic Institute and State University; B.S. Biology, Virginia Polytechnic Institute and State University; 18 years experience in environmental assessment. Contribution: technical writing, document management, and publication.

R. R. Lee, Oak Ridge National Laboratory, Oak Ridge, Tenn.; M.S., Geology, Temple University; B.S., Geology, Temple University; 16 years experience in environmental assessment. Contribution: geology and hydrology.

H. D. Quarles, Oak Ridge National Laboratory, Oak Ridge, Tenn.; Ph.D., Environmental Science, Terrestrial Ecology, University of Virginia; 27 years experience in environmental assessment. Contribution: general and terrestrial ecology.

P.S. Robitaille, Program Manager for Chemical Demilitarization, U.S. Department of Army, Aberdeen Proving Ground, MD; B.S. Biology, University of North Carolina-Wilmington; 10 years experience environmental assessment. Contribution: project coordination.

J. W. Saulsbury, Oak Ridge National Laboratory, Oak Ridge, Tenn.; M.S., Planning, University of Tennessee; B.A., History, University of Tennessee; 12 years experience in environmental assessment. Contribution: socioeconomic resources, utilities, and cultural resources.

J. W. Terry, Ph.D., Physics, Vanderbilt University; M.S., Astronomy, University of South Florida; B.S., Astronomy, University of South Florida; 9 years experience in environmental assessment. Contribution: alternative technology descriptions and waste management.

B. M. Vogt, Oak Ridge National Laboratory, Oak Ridge, Tenn.; Ph.D., Sociology, University of Tennessee; Masters in Urban and Regional Planning (M.U.R.P), University of Hawaii; B.S., Landscape, University of Hawaii; 20 years experience in environmental assessment. Contribution: environmental justice.

G. P. Zimmerman, Oak Ridge National Laboratory, Oak Ridge, Tenn; M.S. Mechanical Engineering, University of Tennessee; B.S. Mechanical Engineering, University of Tennessee; 14 years experience in environmental impact assessment. Contribution: program management and accident analysis.

6. DISTRIBUTION LIST

Note: This list is maintained by the Program Manager for Chemical Demilitarization's Public Affairs Office at (410) 671-3629/1093.

7. INDEX

APPENDIX A

NOTICE OF INTENT

A.1 NOTICE OF INTENT FOR PMCD

[Federal Register: April 14, 2000 (Volume 65, Number 73)]
[Notices]
[Page 20140-20141]
From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr14ap00-56]

DEPARTMENT OF DEFENSE
Department of the Army

Notice of Intent To Prepare an Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot, CO

AGENCY: Department of the Army, DOD.
ACTION: Notice of intent.

SUMMARY: This announces the Army's intent to prepare a site-specific Environmental Impact Statement on the potential impacts of the design, construction, and operation of a facility to destroy the mustard chemical agent and munitions stored at Pueblo Chemical Depot, Colorado. The proposed facility will be used to demilitarize the chemical agent and munitions currently stored at Pueblo Chemical Depot. The Environmental Impact Statement will examine potential environmental impacts of the following destruction facility alternatives:

a. A baseline incineration facility.
b. A full-scale facility to pilot test the single-story incineration process.
c. A full-scale facility to pilot test the alternative technology successfully demonstrated by the Assembled Chemical Weapons Assessment Program—neutralization followed by supercritical water oxidation.
d. A full-scale facility to pilot test the alternative technology successfully demonstrated by the Assembled Chemical Weapons Assessment Program—neutralization followed by biodegradation.
e. No action, an alternative which will continue the storage of the mustard agent and munitions at Pueblo Chemical Depot.

To fulfill the need for destruction of the chemical weapons stockpile at Pueblo Chemical Depot in time to meet the requirements of the Chemical Weapons Convention, a pilot test facility would have to be determined to be as safe as and as cost efficient as baseline incineration. It must also be capable of completing destruction of the Pueblo Chemical Depot stockpile by the later of the Chemical Weapons Convention destruction date or the date the Pueblo Chemical Depot stockpile would be destroyed if baseline incineration were used. This requirement is consistent with the requirement for certification contained in section 142 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999, Public Law 105-261.

DATES: Written comments must be received not later than May 30, 2000, in order to be considered in the Draft Environmental Impact Statement.

ADDRESSES: Written comments may be forwarded to the Program Manager for Chemical Demilitarization, Public Outreach and Information Office (ATTN: Mr. Gregory Mahall), Building E-4585, Aberdeen Proving Ground, MD 21010-4005.

FOR FURTHER INFORMATION CONTACT: Mr. Gregory Mahall at 410-436-1093, by fax at 410-436-5122, or by mail at gjamahall@sbccom-emh1.apgea.army.mil or by mail at the above listed address.

SUPPLEMENTARY INFORMATION: In compliance with the National Environmental Policy Act (40, FR parts 1500-1508), the Army will prepare an Environmental Impact Statement to assess the health and environmental impacts of the design, construction, and operation of a facility to destroy the mustard chemical agent and munitions stored at Pueblo Chemical Depot, Colorado. Public law and international treaty require the mustard chemical agent and munitions to be destroyed. This Environmental Impact Statement will analyze the impact of the various methods of destroying the Pueblo stockpile. This action is proposed in concert with an announcement to programmatically address the process for follow-on tests for assembled chemical weapons destruction technologies at one or more sites. These two separate and distinct analyses serve complementary but distinct purposes.

This site-specific Environmental Impact Statement continues the process that began when Congress established the Program for Chemical Demilitarization in Public Law 99-145 in 1985. This law requires the destruction of the chemical weapons stockpile by a deadline established by treaty. That date is April 2007. This requirement still exists, notwithstanding the establishment of the Assembled Chemical Weapons Assessment Program. The Chemical Demilitarization Program established by Public Law 99-145 published a Programmatic Environmental Impact Statement in January 1988. The Record of Decision states that the stockpile of chemical agents and munitions should be destroyed in a safe and environmentally acceptable manner by on-site incineration. Site-specific Environmental Impact Statements that tier off the Programmatic Environmental Impact Statement have been prepared for Johnston Atoll Chemical Agent Disposal System, Tooele Chemical Agent Disposal Facility, Anniston Chemical Agent Disposal Facility, Umatilla Chemical Agent Disposal Facility, and Pine Bluff Chemical Agent Disposal Facility.

The specific purpose of the current analysis is to determine the environmental impacts of the alternatives that could accomplish the destruction of the stockpile at Pueblo Chemical Depot by the required destruction date of April 2007, including the alternatives of using the technologies successfully demonstrated by the Assembled Chemical Weapons Assessment Program. In the course of the environmental impact analysis it will be determined whether construction of a full-scale plant operated initially as a pilot facility and utilizing any of the technologies successfully demonstrated in the Assembled Chemical Weapons Assessment Program is capable of destroying the stockpile at Pueblo Chemical Depot by the required destruction date (or as soon thereafter as could be achieved by constructing a destruction facility using the baseline incineration technology), and of doing so as safely as use of the baseline incineration technology. The Record of Decision, based on the 1988 Programmatic Environmental Impact Statement, does not limit or predetermine the results of this consideration, and it does not dictate the decision to be made in the Record of Decision following completion of the Environmental Impact Statement for this action at Pueblo Chemical Depot. The Army 1988 Programmatic Environmental Impact Statement will be used to cover Pueblo Chemical Depot actions in the event that an incineration technology is selected as the preferred alternative at the conclusion of the analysis of all the available alternatives.

The second document announcing the programmatic analysis for follow-on pilot testing of successful Assembled Chemical Weapons Assessment Program demonstration tests pursuant to the process established by Congress in Public Laws 10-208 and 10-261 addresses a distinct but related purpose. That purpose is to determine which technologies can be pilot tested and if so, at which site or sites. That Environmental Impact Statement will be distinct from this site-specific Environmental Impact Statement in that its emphasis will be on the feasibility of pilot testing one or more of the demonstrated and approved Assembled Chemical Weapons Assessment Program technologies considering the unique characteristics of the alternative sites, to include Pueblo Chemical Depot. The Environmental Impact Statement will not consider the use of a full-scale facility operated initially as a pilot facility at Pueblo Chemical Depot; as discussed above, this alternative will be considered in the site specific Environmental Impact Statement for Pueblo Chemical Depot. At the conclusion of both of these Environmental Impact Statements, the same officials will issue the Records of Decision.

The Army will hold scoping meetings to aid in determining the significant issues related to the proposed action which will be addressed in the Environmental Impact Statement. The scoping process will incorporate public participation, including Federal, State of Colorado, and local agencies, as well as residents within the affected environment. The dates, times, and locations of scoping meetings will be announced in appropriate news media at least 15 days prior to these meetings.

Dated: April 10, 2000.
Raymond J. Fatz,
Deputy Assistant Secretary of the Army (Environment, Safety, and
Occupational Health) OASA (I&E).
[FR Doc. 00-9337 Filed 4-13-00; 8:45 am]
BILLING CODE 3710-08-M

A.2 NOTICE OF INTENT FOR ACWA

Federal Register: April 14, 2000 (Volume 65, Number 73)]
[Notices]
[Page 20139-20140]
From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr14ap00-55]

DEPARTMENT OF DEFENSE
Department of the Army

Environmental Impact Statement for Follow-On Tests Including Design, Construction and Operation of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites

AGENCY: Program Manager, Assembled Chemical Weapons Assessment, Department of Defense.
ACTION: Notice of intent.

SUMMARY: This announces the Army's intent to prepare an Environmental Impact Statement on the potential impacts of the design, construction and operation of one or more pilot test facilities for assembled chemical weapon destruction technologies at one or more chemical weapons stockpile sites, potentially simultaneously with any existing demilitarization programs and schedules at these sites. The size of the pilot tests and the location of the test facilities will be determined in this process.

DATES: Written comments must be received not later than May 30, 2000 in order to be considered in the Draft Environmental Impact Statement.

ADDRESSES: Written comments may be forwarded to the Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E-5101, Room 219, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5424.

FOR FURTHER INFORMATION CONTACT: Ms. Ann Gallegos at 410-436-4345, by fax at 410-436-5297, or via email at ann.gallegos@sbccom.apgea.army.mil, or Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E-5101, Room 212, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5424.

SUPPLEMENTARY INFORMATION: This proposed action continues the process that began when Congress established the Assembled Chemical Weapons Assessment Program through passage of Public Law 104-208. The authorizing legislation instructed the Department of Defense to identify and demonstrate alternatives to baseline incineration for the destruction of assembled chemical weapons. Baseline incineration is the technology and process in place at the Johnston Atoll in the Pacific and at Deseret Chemical Depot in Utah. Assembled chemical weapons are munitions containing both chemical agents and explosives that are stored in the United States unitary chemical weapons stockpile. This includes rockets, projectiles, and mines. Unitary agents include chemical blister agents (e.g., the mustard H, HD, and HT) and chemical nerve agents (e.g.,GB (Sarin) and VX).

With the National Defense Appropriations Act for Fiscal Year 1999, Congress directed the Program Manager, Assembled Chemical Weapons Assessment to plan for the pilot testing of alternatives technologies.

While all of the chemical stockpile sites were initially believed to be potential test sites, Edgewood Chemical Activity in Maryland, Newport Chemical Depot in Indiana, and Johnston Atoll in the Pacific Ocean have been eliminated from any consideration. Chemical stockpile sites at Edgewood and Newport will not be considered because no assembled chemical weapons are at those locations. Johnston Atoll will not be considered because all chemical weapons at the site will be destroyed before the National Environmental Policy Act analysis can be completed.

Sites at Anniston Chemical Activity in Alabama, Pine Bluff Chemical Activity in Arkansas, Pueblo Chemical Depot in Colorado, and Blue Grass Chemical Activity in Kentucky are being considered. Deseret Chemical Depot in Utah and Umatilla Chemical Depot in Oregon are not currently being considered because the current schedule for those plants indicates that the assembled chemical weapons will be destroyed prior to the time that a pilot facility would be ready to operate. If new information indicates that assembled chemical weapons in sufficient quantity will remain at these sites, then placement of the pilot facility at those sites will be analyzed.

Technologies under consideration include a variety of processes, such as, chemical neutralization, biological treatment, and supercritical water oxidation. The Program Manager, Assembled Chemical Weapons Assessment pilot tests will not halt or delay the operation or construction of any baseline incineration facility currently in progress. Transportation of assembled chemical weapons between stockpile sites is precluded by public law and will not be considered.

Alternatives that will be considered in the Environmental Impact Statement are: (a) No action, (b) pilot test of chemical neutralization followed by super critical water oxidation, and (c) pilot test of chemical neutralization followed by biological treatment.

There is a second Notice of Intent, entitled "Notice of Intent to Prepare an Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot, Colorado." The focus of this complementary Environmental Impact Statement will be specifically on what technology should be used for the destruction of the chemical weapons stockpile at Pueblo Chemical Depot. The focus of the Assembled Chemical Weapons Assessment Environmental Impact Statement is on whether or not pilot testing of any Assembled Chemical Weapons Assessment technology should be conducted, and if so where, but it will leave to the Pueblo Chemical Depot Environment Impact Statement the question whether a full-scale facility operated initially as a pilot facility should be constructed to destroy the stockpile at that location. The emphasis for the Assembled Chemical Weapons Assessment document is to consider Assembled Chemical Weapons Assessment technologies and the various stockpile sites that may be suitable for conducting pilot tests, considering such factors as existing facilities, resource requirements for each technology and the ability of the site to provide those resources, munitions configurations and availability at each site at the time actual testing would begin. At the conclusion of both these Environmental Impact Statements, the same officials will issue The Records of Decision.

During scoping meetings, the Program Manager, Assembled Chemical Weapons Assessment is seeking to identify significant issues related to the proposed action. The Program Manager, Assembled Chemical Weapons Assessment desires information on: (1) The potential chemical weapons stockpile sites and surrounding areas, (2) concerns regarding the testing and/or operation of multiple technologies at these sites, (3) issues regarding the scale of the pilot test facilities, and (4) specific concerns regarding any potential technologies. Individuals or organizations may participate in the scoping process by written comment or by attending public meetings to be held in Alabama, Arkansas, Colorado, Kentucky and the Washington, DC metropolitan area. The dates, times, and locations of these meetings will be provided at least 15 days in advance by public notices in the news media serving the regions where the meeting will be located. The public meeting in Colorado will be held in conjunction with the public meeting on the site-specific Environmental Impact Statement.

Dated: April 10, 2000.
Raymond J. Fatz,
Deputy Assistant Secretary of the Army, (Environment, Safety, and
Occupational Health) OASA (I&E).
[FR Doc. 00-9336 Filed 4-13-00; 8:45 am]
BILLING CODE 3710-08-M

APPENDIX B

SUMMARY OF SUPPORT STUDIES

The alternatives for disposal of mustard-filled chemical munitions stored at PCD are supported by numerous studies.

1. GA Technologies, Inc. 1987a, 1987b, and 1987c. *Risk Analysis of the On-Site Disposal of Chemical Munitions*, *Risk Analysis of the Disposal of Chemical Munitions at National or Regional Sites*, and *Risk Analysis of the Continued Storage of Chemical Munitions*.

A major public concern with disposal of chemical munitions has to do with risks from accidents associated with the various CSDP disposal alternatives. Specific concerns have included comprehensiveness of the risk analysis; potential bias in the analysis; failure to consider site-specific inventories and associated activities, including variation in time-at-risk for different alternatives; treatment of common mode failures and human error in the analysis; and treatment of accidental release source terms. These reports support addressing the concerns and the incorporation of revised operational concepts associated with the various activities needed to implement each programmatic alternative (e.g., packaging, on-site and off-site transportation, and improvements in plant design).

2. Jacobs Engineering Group, Inc., and Schneider EC Planning and Management Services 1987. *Emergency Response Concept Plan for the Chemical Stockpile Disposal Program.*

In response to public concerns that the FPEIS treatment of emergency preparedness was inadequate and insensitive to site-specific differences in inventory and preparedness needs, this study develops a standard approach to be used in implementing site-specific plans. This approach specifically includes development of emergency planning zones based on the site-specific parameters of the CSDP risk analysis and varying potential for taking protective actions. Alternative warning systems and protective actions are considered in the study, and recommendations are made for organizational communication between Army and civilian authorities. The approach also addresses emergency planning and preparedness concepts for fixed-site and transportation corridors. The Army has determined that emergency planning activities are a significant mitigative action associated with the program.

3. The MITRE Corporation 1987a. *Risk Analysis Supporting the Chemical Stockpile Disposal Program (CSDP).*

In response to the need to integrate complex risk analyses of diverse CSDP alternatives, the Army contracted the MITRE Corporation to monitor the risk analyses during their preparation and to prepare an integrated summary of the risk analyses.

4. The MITRE Corporation 1987b. *Transportation of Chemical Agents and Munitions: A Concept Plan.*

Early in the CSDP planning process, public concerns relating to the treatment of stockpile transport included the premature rejection of alternative transport modes (i.e., air and marine) and the lack of detail as to how such movements would take place. Comments also included concerns about the risks and hazards of such movement. As a result of these concerns, the Army sponsored the study and development of a transportation concept plan for on-site and off-site movement. This study, which involved a panel of hazardous material transportation experts, developed preliminary operational plans for movement by truck (on-site only), rail, air, and water. Design-basis recommendations were also made regarding the type of munition packaging to be used during transport.

5. The MITRE Corporation 1987c and 1987d. *Analysis of Existing Hazardous Material Containers for Transporting Chemical Munitions* and *Conceptual Design of a Chemical Munition Transport Packaging System*.

The use of a Chemical Agent Munition Package Transporter (CAMPACT) for off-site movement of stockpile items was proposed. This package was based on a shipping container under development by the U.S. Department of Energy for the movement of radioactive materials. The Army contracted with the MITRE Corporation to reconsider the use of the CAMPACT and develop packaging concepts based on transportation accident thresholds for both on-site and off-site movement (as also identified by the panel of hazardous material transportation experts employed on the above task). Such packages have not been fabricated or tested, but the Army feels that these package concepts are more applicable to CSDP needs than is the CAMPACT. Furthermore, the proposed concepts represent the state of the art in packaging.

6. The MITRE Corporation 1988. *Conceptual Design of a Packaging System for On-Site Transport of Chemical Munitions*.

This report describes a conceptual packaging system to be used for transporting chemical munitions from existing storage areas to a demilitarization building located on the same site. The packaging system concept is based on design criteria for transportation safety and logistics. It also incorporates special features related to thawing frozen mustard agent prior to processing and handling as well as transporting containers with leaking munitions inside. This report describes the package concept and includes quantitative analyses of the basic structural and thermal design features.

The goal for the on-site transport package is the provision of safe and efficient munitions movement from existing on-site storage facilities to an on-site container-handling building to be located adjacent to the munitions demilitarization building. The basic safety criterion is the prevention of chemical agent release into the environment during normal conditions of transport or as the result of an accident during transportation. The basic efficiency criterion requires that the package system support the maximum feed rate of munitions into the destruction equipment in the munitions demilitarization building.

The conceptualized container consists of a cylindrical inner container surrounded by thermal insulation and a cylindrical outer steel shell. Two cylindrical shells provide redundant containment for leaks of agent from munitions. The entire cylindrical assembly is supported on shock-isolating springs within a rectangular support frame. Separate doors seal inner and outer cylinders, and gas sampling ports provide for the remote detection of leaking munitions. The container doors also include sealed power feed-through fixtures to accommodate a modular convection heating unit to be installed as needed for thawing frozen mustard agent munitions in the container.

7. U.S. Army 1987a. *Chemical Stockpile Disposal Program: Monitoring Concept Plan.*

The Army's concept plan addresses the manner in which all activities associated with stockpile disposal would be monitored. Although this study identifies various monitoring technologies, it does not attempt to assign a particular monitor to each location during the process. Rather, it includes the basic concepts and logic relevant to developing detailed monitoring programs for each disposal alternative. The report addresses the monitoring of industrial pollutants as well as chemical agents; it also addresses organizational monitoring, including independent monitoring. The results of this study have been incorporated into the FPEIS.

8. U.S. Army 1987b. *Mitigation of Public Safety Risks of the Chemical Stockpile Disposal Program.*

The Army, with the assistance of the MITRE Corporation, Oak Ridge National Laboratory, the Ralph M. Parsons Company, and GA Technologies, Inc., identified mitigation measures that would reduce the probability and/or magnitude of an accidental release of chemical agent for all CSDP disposal alternatives. Using accident scenarios identified in the CSDP risk analysis (GA Technologies, Inc., 1987a, 1987b, and 1987c) as a baseline, this report screened from consideration those accident sequences with a frequency less than 10^{-8} per year or a lethal downwind release less than 0.5 km (0.3 mile) (for on-site activities only). The sequences remaining were analyzed in detail to identify potential mitigative measures for reducing risk.

9. U.S. Army 1987c. *Chemical Agent and Munition Disposal: Summary of the U.S. Army's Experience.*

In response to comments regarding the insufficient documentation of past experience in destroying chemical agents, the Army prepared a report documenting CSDP-related experience. This report identifies major programs at the Rocky Mountain Arsenal near Denver, Colorado, and the Chemical Agent Munitions Disposal System (CAMDS) at Tooele, Utah. Process effluents associated with each disposal campaign are also identified. Additionally, the report incorporates data on products of incomplete combustion (PICs) and principal organic hazardous constituents (POHCs) for incineration of agent GB. It also describes the currently proposed disposal process, estimated effluents, and future incineration tests at CAMDS, including PICs and POHCs tests for mustard agent and agent VX.

10. Carnes, S. A., et al. 1989. *Emergency Response Concept Plan for Pueblo Depot Activity and Vicinity*.

This report develops information and methodologies that bear on two major decisions for the CSDP emergency preparedness program—determining emergency planning zones and selecting protective action strategies. A conceptually simple methodology for determining emergency planning zone (EPZ) boundaries is developed and applied to the PCD stockpile, and a recommended EPZ and set of boundaries are identified. The EPZ consists of two zones, an immediate response zone (IRZ) with a radius of approximately 10 km (6 miles) from the storage area and proposed disposal site and a protective action zone (PAZ) with a radius of approximately 35 km (22 miles) from those locations. Most boundaries are set using natural features of the landscape or other landmarks with which the local populace is familiar (e.g., the Columbia River, county boundaries, roads, and highways).

The report identifies the advantages and disadvantages of six categories of protective actions (evacuation, in-place sheltering, respiratory protection, protective clothing, prophylactic drugs, and antidotes) and various options among these categories. Potentially suitable options for the IRZ and PAZ general public and institutional populations are identified, and preliminary recommendations are made. For the general population in the IRZ, the recommended option is evacuating with respiratory protection, although other combinations of options (e.g., using respiratory protection while sheltering) may also be suitable for some persons. For institutionalized or impaired persons in the IRZ (e.g., school children and hospitalized patients), positive pressurization of a "safe" room in a house or building is recommended. For the PAZ, evacuation is recommended for all persons.

The viability of the recommended EPZ and the effectiveness of the recommended protective actions depend on the adoption and implementation of appropriate standards for command and control decisions and for alert and notification systems. Given the possibility of rapid onset of accidents at PCD and the proximity of civilian populations in the IRZ, an overall command and control structure must be able to provide a decision on warning and protective actions in less than five minutes from accident detection. Somewhat more time is available for the PAZ.

11. U.S. Army 1994. *Disposal of Chemical Agents and Munitions Stored at Pueblo Depot Activity—Phase I Environmental Report*.

The Phase I report reviews information that became available after publication of the FPEIS and site-specific information too detailed to be included in the FPEIS. The purpose of the Phase I report is to determine whether the new information or the more detailed site-specific information changes the FPEIS conclusions favoring on-site disposal of chemical agents at PCD. The report also identifies the presence of significant environmental resources that could be affected by on-site disposal operations and possible accidental releases of chemical agent. Site-specific information on meteorology and changes in residential populations were used to recalculate risk and fatality estimates. As in the FPEIS, the Phase I report concludes that on-site disposal is the preferred alternative. The Phase I report describes human populations, meteorology, air quality, surface water, groundwater, land use, terrestrial and aquatic biota, socioeconomics, and aircraft activity. The report concludes that none of these resources should prevent or delay implementation of on-site disposal at PCD. Technology maturity and risk assurance are also reviewed in the report.

12. ANL (Argonne National Laboratory) 1994. *Chemical Stockpile Disposal Program: Review and Comment on the Phase I Environmental Report for the Pueblo Depot Activity, Pueblo, Colorado.*

This report is the result of an independent review of the U.S. Army Phase I environmental report (item 11, above) for the disposal program at PCD. As noted, the Phase I report addressed new and additional site-specific information not incorporated in the FPEIS. This review made recommendations for the scope and content of the site-specific DEIS and evaluated whether the new data presented in the Phase I report would alter the decision in favor of on-site disposal that was reached in the FPEIS. The independent review concluded that, based on the methods and assumptions presented in the FPEIS, the inclusion of more detailed site-specific data in the Phase I report does not change the decision reached in the FPEIS for on-site disposal at PCD. The review recommended that alternative assumptions about meteorological conditions be considered and that site-specific data on water, ecological, socioeconomic, and cultural resources; seismicity; and emergency planning and preparedness be considered explicitly in the site-specific DEIS decision-making process.

13. NRC (National Research Council) 1994. *Recommendations for the Disposal of Chemical Agents and Munitions*

The Army undertook a study of chemical munitions disposal technologies in the 1970s, including the assessment of incineration and chemical neutralization methods. In 1982, that study culminated in the proposal for the use of incineration technology, which has subsequently been incorporated into the baseline system. In 1984, another NRC committee reviewed the chemical stockpile program and possible disposal technologies, and endorsed incineration as the method of choice. The NRC Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program monitored the construction and Operational Verification Testing of a prototype facility using the baseline technology, JACADS. To address public concern over incineration, Congress, in 1992, directed the Army to evaluate alternative disposal approaches that might be safer and more cost effective than incineration and that could complete the disposal operations within the required time frame. The Army was further directed to report to Congress on potential alternative technologies by the end of 1993 and include the recommendations of NRC. This NRC report provides that information. The NRC committee drew upon its long experience with the disposal program and on the report of the Committee on Alternative Chemical Demilitarization Technologies in the preparation of recommendations. In conducting its assessment, the committee was concerned primarily with the technical aspects of safe disposal operations. However, the committee recognized that other issues would also influence the selection of disposal technologies, including public concerns. A public forum was convened in 1993 to listen to the public and do discuss the criteria for evaluating alternative technologies.

14. NRC (National Research Council) 1999. *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*

The U.S. Army is in the process of destroying the United States' stockpile of aging chemical weapons. The Army selected incineration as the preferred "baseline" destructions technology and currently has two operating facilities—one on Johnston Atoll and another at the Deseret Chemical Depot near Tooele, Utah. In response to significant public concern and political opposition to the incineration process, chemical neutralization based processes are being studied as possible alternatives to incineration. The NRC was asked by the Army Program Manager for ACWA (who is responsible for evaluation of the neutralization alternatives) to perform an independent technical review and evaluation of seven neutralization technology packages which had passed the DOD initial screening criteria. The NRC formed the Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons. This report contains the committee's findings and recommendations and details the factual data, the information supplied by the technology providers, and the analyses and arguments that support the findings and recommendations.

15. NRC (National Research Council) 2000. *Evaluation of Demonstration Test Results of the Alternative Technologies for Demilitarization of Assembled Chemical Weapons, a Supplemental Review*

When the NRC's Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons first report was prepared, the committee did not have the benefit of evaluating the results of neutralization technology demonstrations. Subsequently the Army Program Manager for ACWA requested that the committee evaluate both the technology providers' test reports and the Army's evaluations to determine if the demonstrations changed the committee's earlier findings or recommendations. This report is a supplemental review evaluating the impact of the three demonstrations tests on the committee's original findings and recommendations.

APPENDIX B REFERENCES

ANL (Argonne National Laboratory) 1994. *Chemical Stockpile Disposal Program: Review and Comment on the Phase I Environmental Report for the Pueblo Depot Activity, Pueblo, Colorado,* ANL/EAD/TM-14, Argonne National Laboratory, Argonne, Ill.

Carnes, S. A., et al. 1989. *Emergency Response Concept Plan for Pueblo Depot Activity and Vicinity*, ORNL/TM-11098, Oak Ridge National Laboratory, Oak Ridge, Tenn.

GA Technologies, Inc. 1987a. *Risk Analysis of the On-Site Disposal of Chemical Munitions*, GAC-18562 and SAPEO-CDE-IS-87010, GA Technologies, Inc., La Jolla, Calif.

GA Technologies Inc. 1987b. *Risk Analysis of the Disposal of Chemical Munitions at National or Regional Sites*, GAC-18563 and SAPEO-CDE-IS-87008, GA Technologies, Inc., La Jolla, Calif.

GA Technologies Inc. 1987c. *Risk Analysis of the Continued Storage of Chemical Munitions*, GAC-18564 and SAPEO-CDE-IS-87009, GA Technologies, Inc., La Jolla, Calif.

Jacobs Engineering Group, Inc., and Schneider EC Planning and Management Services 1987. *Emergency Response Concept Plan for the Chemical Stockpile Disposal Program*, SAPEO-CDE-IS-87007, Aberdeen Proving Ground, Md.

The MITRE Corporation 1987a. *Risk Analysis Supporting the Chemical Stockpile Disposal Program (CSDP)*, SAPEO-CDE-IS-87014, MITRE Corporation, McLean, Va.

The MITRE Corporation 1987b. *Transportation of Chemical Agents and Munitions: A Concept Plan*, SAPEO-CDE-IS-87003, MITRE Corporation, McLean, Va.

The MITRE Corporation 1987c. *Analysis of Existing Hazardous Material Containers for Transporting Chemical Munitions*, WP-8700263, MITRE Corporation, McLean, Va.

The MITRE Corporation 1987d. *Conceptual Design of a Chemical Munitions Transport Packaging System*, WP-8700347, MITRE Corporation, McLean, Va.

The MITRE Corporation 1988. *Conceptual Design of a Packaging System for On-Site Transport of Chemical Munitions*, WP-87W00531, MITRE Corporation, McLean, Va.

NRC (National Research Council)1994. *Recommendations for the Disposal of Chemical Agents and Munitions*, National Academy Press, Washington, D.C.

NRC (National Research Council)1999. *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*, National Academy Press, Washington, D.C.

NRC (National Research Council) 2000. *Evaluation of Demonstration Test Results of the Alternative Technologies for Demilitarization of Assembled Chemical Weapons, a Supplemental Review*, National Academy Press, Washington, D.C.

U.S. Army 1986. *Chemical Stockpile Disposal Program Draft Programmatic Environmental Impact Statement*, Aberdeen Proving Ground, Md.

U.S. Army 1987a. *Chemical Stockpile Disposal Program: Monitoring Concept Plan*, SAPEO-CDE-IS-87006, Aberdeen Proving Ground, Md.

U.S. Army 1987b. *Mitigation of Public Safety Risks of the Chemical Stockpile Disposal Program*, Aberdeen Proving Ground, Md.

U.S. Army 1987c. *Chemical Agent and Munition Disposal: Summary of the U.S. Army's Experience*, SAPEO-CDE-IS-87005, Aberdeen Proving Ground, Md.

U.S. Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1–3, Aberdeen Proving Ground, Md.

U.S. Army 1994. *Disposal of Chemical Agents and Munitions Stored at Pueblo Depot Activity—Phase I Environmental Report*, Aberdeen Proving Ground, Md.

APPENDIX C

MATURITY OF INCINERATION TECHNOLOGY

This appendix provides a status report on the Army's operational experience with incineration technology since the time of the Final Programmatic Environmental Impact Statement (FPEIS) for the Chemical Stockpile Disposal Program (CSDP) (U.S. Army 1988). Appendix D of the FPEIS documents the Army's experience prior to 1987. "Maturity" of the technology refers to the continuing refinement of designs and procedures from the conceptual design to the operation of a destruction facility. The performance and design of the Johnston Atoll Chemical Agent Disposal System (JACADS) the Army's prototype incineration facility, and the Tooele Chemical Agent Disposal Facility (TOCDF) have been refined and improved based upon U.S. Army and U.S. Environmental Protection Agency (EPA) reviews. Regulatory approvals of the design are required from the State of Colorado prior to the start of construction and operation of the proposed PCD facility.

C.1 BACKGROUND AND SUMMARY

The Army has previously conducted chemical demilitarization operations at former production facilities at Rocky Mountain Arsenal (RMA), located in Denver, Colorado, and at the Chemical Agent Munitions Disposal System (CAMDS) near Tooele, Utah. These operations were in addition to the destruction of munitions and agent at JACADS and TOCDF.

This appendix discusses the performance of JACADS, which completed destruction operations on Johnston Island in the Pacific Ocean on November 29, 2000, and of the operational TOCDF facility. Tables C.1 and C.2 summarize the U.S. Army's experience in industrial scale destruction of lethal chemical agents and munitions before and after the availability of the JACADS and TOCDF facilities.

The FPEIS concluded that no significant human health impacts would be expected during normal plant destruction operations. This conclusion has been supported by operational experience and equipment advancements that have been made since the FPEIS. However, agent has been detected outside the JACADS and TOCDF facilities. Nevertheless, these events posed no serious health threat to nearby personnel.

At the time the FPEIS was published, initial polychlorinated biphenyl (PCB) incineration tests had been conducted at CAMDS. Based on these tests, it was concluded that PCB incineration would result in no significant human health effects. This conclusion is reinforced by Toxic Substances Control Act (TSCA) test burns conducted at JACADS and at TOCDF (see Sects. C.2.1 and C.3.1), PCB emissions from these incinerators were substantially lower than commercial PCB-permitted units within the continental United States.

As discussed below, air quality impacts from emissions during normal operation have been evaluated against standards applicable to criteria pollutants. Hydrogen chloride (HCl), nitrogen oxides (NO_x), particulate matter, and sulfur dioxide (SO_2) emissions were monitored during the Army's JACADS and TOCDF tests and were found to be within EPA regulatory limits (see Sects. C.2.1 and C.3.1).

Table C.1. Summary of U.S. Army's pre-JACADS experience in industrial-scale chemical agent/munitions destruction

Operation	Description	Date	Agent	Site[a]	Process[b]	Quantity (1,000 kg)	Quantity (1,000 lb)
Project Eagle Phase I	Ton containers	July 72–Mar.74	H	R	I	2,008.5	4,428.0
Project Eagle Phase I	Ton containers	July 72–Mar. 74	HD	R	I	777.5	1,714.0
Project Eagle Phase II	M34 cluster bombs	Oct. 73–Nov. 76	GB	R	N/I	1,873.2	4,129.6
Project Eagle Phase II (Expanded)	Underground storage tanks	Sept. 74–Nov. 74	GB	R	N	171.5	378.0
Project Eagle Phase II (Expanded)	Ton containers	May 75–Nov. 75	GB	R	N/I	1,635.0	3,604.5
Project Eagle Phase II (Expanded)	Honest John warhead (M139)	Apr. 75–Nov. 76	GB	R	N/I	34.7	76.5
Chemical Agent Identification Sets Disposal	Chemical agent identification sets	May 31–Dec. 82	(c)	R	I	16.6	36.7
M55 Rocket Disposal		Sept. 79–Apr. 81	GB	C	N/I	58.1	128.0
Agent Injection Incineration Tests		Apr. 81–Jan. 84	GB	C	I	5.1	11.2
Agent Injection Incineration Tests	Ton containers	June 81–Aug. 84	VX	C	I	3.6	7.9
155-mm Projectile Disposal		July 81–July 82	GB	C	N	27.4	60.5
105-mm Projectile Disposal		Mar. 82–July 82	GB	C	N		
In-Situ Agent Incineration		Oct. 82–Dec. 83	GB	C	I	8.0	17.6
M55 Rocket Incineration		Nov. 85–Nov. 86	GB	C	I	1.0	2.3
Liquid Incinerator Test		Aug. 85–Aug. 86	GB	C	I	17.2	37.9
Agent BZ Disposal		May 88–Sept. 89	BZ[d]	P	I	42.6	94.0
Liquid Incinerator Test		Sept. 89–Oct. 89	VX	C	I	18.1	40.0
Total						6,698.1	14,766.7

[a]R refers to Rocky Mountain Arsenal, C refers to Chemical Agent Munitions Disposal System, and P refers to Pine Bluff Arsenal.

[b]N refers to agent neutralization only; I refers to incineration of agent and explosive (and/or metal parts thermal decontamination); N/I refers to agent neutralization and explosive incineration (and/or metal parts thermal decontamination).

[c]Agents include phosgene, chloropicrin, mustard, lewisite, cyanogen chloride, nitrogen mustard, and GB.

[d]The incapacitating agent BZ is not lethal.

Table C.2. Summary of U.S. Army's experience in industrial-scale incineration of chemical agents/munitions at JACADS and TOCDF

Munition type	Agent type	Quantity of agent (1000 kg)	Quantity of agent (1000 lb)
***Johnston Atoll Chemical Agent Disposal System (JACADS), Johnston Island, Pacific Ocean*[a]**			
M55 (115-mm) rockets/M56 warheads	GB	283.4	625.0
MC-1 (750-lb) bombs	GB	304.0	670.3
MK-94 (500-lb) bombs	GB	125.9	277.6
M121/A1 (155-mm) projectiles	GB	316.1	696.8
M426 (8-in.) projectiles	GB	85.6	188.8
M360 (105-mm) cartridges	GB	35.8	79.0
Ton containers	GB	45.1	99.4
M55 (115-mm) rockets/M56 warheads	VX	63.0	138.9
M121/A1 (155-mm) projectiles	VX	116.2	256.1
M426 (8-in.) projectiles	VX	95.5	210.5
M23 land mines	VX	63.4	139.7
Ton containers	VX	44.2	97.4
M60 (105-mm) projectiles	HD	61.4	135.5
M2A1 (4.2-in.) cartridges	HD	118.8	262.0
M104 (155-mm) projectiles	HD	0.6	1.3
M110 (155-mm) projectiles	HD	30.1	66.3
Ton containers	HD	52.4	115.6
JACADS total[b]		1841.5	4059.8
***Tooele Chemical Agent Disposal System (TOCDF), Tooele, Utah*[b]**			
M360 (105-mm) projectiles	GB	433.8	956.4
M55 (115-mm) rockets	GB	127.0	280.1
MC-1 (750-lb) bombs	GB	445.4	981.9
Ton containers	GB	3,356.5	7,339.9
TOCDF total		4,362.7	9,618.3
JACADS and TOCDF total		6,204.3	13,678.0

[a]The JACADS facility was operational from July 1990 through November 2000. All chemical munitions on Johnston Island have been destroyed.

[b]The TOCDF facility became operational in August 1996.

Sources: Derived from "PMCD: At a Glance: Total Munitions Processed, Program Manager for Chemical Demilitarization, U.S. Army, Aberdeen Proving Ground, Md., December 5, 2000, URLs: http://www-pmcd.apgea.army.mil/aag_jacads.asp and http://www-pmcd.apgea.army.mil/aag_tocdf.asp (both accessed February 19, 2001); and "U.S. Chemical Weapons Stockpile Information Declassified," News Release No. 024-96, Office of Assistant Secretary of Defense, Jan. 22, 1996.

C.2 EXPERIENCE IN DISPOSAL OPERATIONS WITH THE JOHNSTON ATOLL CHEMICAL AGENT DISPOSAL SYSTEM

Johnston Atoll is a coral atoll located in the central Pacific Ocean about 1300 km (825 miles) southwest of Honolulu, Hawaii. Johnston Island, the largest island of the atoll, has been a storage site for three types of chemical agents: GB, VX, and mustard (H and HD). These agents were present in a variety of stockpile items, including rockets, mines, projectiles, bombs, and ton containers.

JACADS is located on Johnston Island. This facility, which became operational in June 1990, was the first full-scale plant capable of destroying all types of agents and munitions. JACADS uses the reverse assembly incineration process to meet the environmental and safety requirements for stockpile destruction. Figure C.1 is a representation of the JACADS reverse assembly process—a munition disassembly step followed by incineration of the liquid agents and the munition components in four separate furnaces or incinerators. The JACADS munition disassembly equipment and the incinerators were developed as a result of experience gained with destruction of the stockpile at RMA and more recently at CAMDS.

The Army began constructing JACADS in January 1986. Systemization (i.e., the system-wide operational checkout of all electrical and mechanical equipment prior to operations with actual chemical agents) was completed in June 1990, and chemical agent destruction operations began at that time.

Safety and environmental considerations have always been important in JACADS operations. Since the fall of 1988, an extensive effort has been made to ensure that the JACADS in-plant agent-monitoring systems maintain the necessary precision and accuracy to detect agent at the low agent concentration detection limit (i.e., the parts per trillion level).

Based on a recommendation from the National Research Council (NRC), a perimeter monitoring system (i.e., external to the plant) was implemented at Johnston Island in October 1990. The perimeter monitoring system is designed to provide a historical record of any major release of agent. The perimeter monitoring system consists of eight agent sampling stations, located around the perimeter of the JACADS facility and chemical storage area.

Four meteorological stations collect data that can be used to model a potential agent release. Data for certain criteria pollutants (i.e., pollutants for which ambient standards have been established under the Clean Air Act) are also being collected at these four stations. These criteria pollutants are ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and suspended particulate matter. This additional monitoring is not required by regulation; it reflects a voluntary commitment by the Army to check the impact of JACADS emissions on ambient air quality.

Representatives from the U.S. Department of Health and Human Services (DHHS) conducted a February 1990 preoperational review, concentrated in the area of perimeter and workplace monitoring and medical support capabilities. In a letter documenting the results of this visit (PMCD 1990), DHHS made various recommendations but concluded that all possible actions in the engineering field had been taken to ensure the safety of the workers and the island population. The NRC and EPA also provided oversight for JACADS testing and operations.

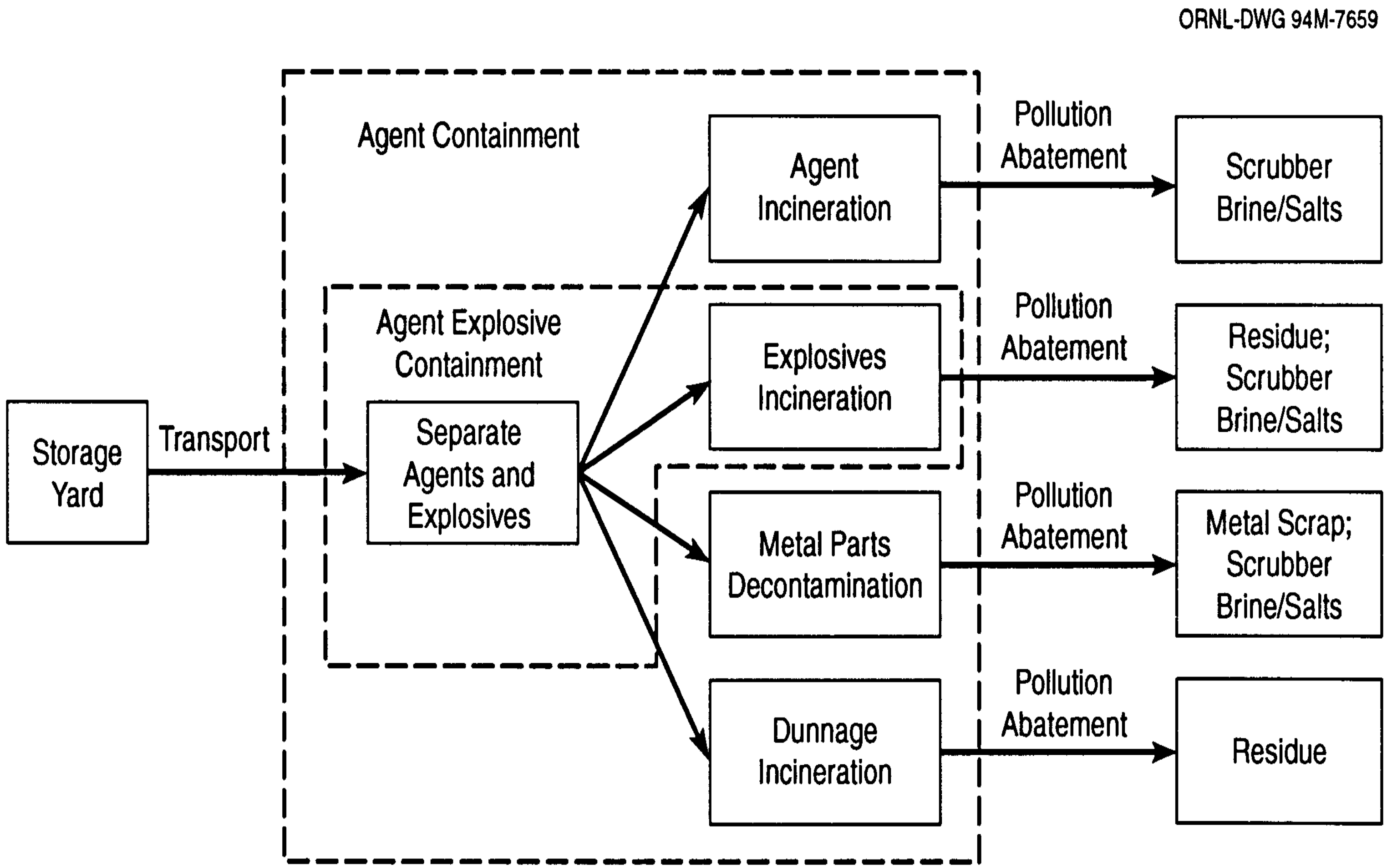


Fig. C.1. Schematic diagram of the incineration process employed at the Johnston Atoll Chemical Agent Disposal System.

C.2.1 Emission and Performance Data from JACADS Facility Tests

C.2.1.1 TSCA trial burns

Trial burns, followed by tests involving actual chemical agent destruction operations, are required by the EPA to obtain a permit to incinerate PCBs. Small amounts of PCBs are present in the rocket shipping and firing tubes. Two TSCA trial burns were conducted without agent in the Deactivation Furnace System (DFS) in February 1990; a third TSCA trial burn was conducted with agent GB in October 1990. The trial burns consisted of feeding PCB-contaminated shipping and firing tubes and the complete rocket motor section into the DFS. Representatives from EPA Headquarters witnessed the TSCA trial burns, and the analysis was conducted under EPA guidance. HCl and particulate emissions were below federal regulatory limits. A PCB destruction and removal (DRE) efficiency of 99.9999%, as required by the TSCA regulations, was achieved in all three burns. Dioxins and furans were not detected in the JACADS stack emissions, with the exception of tetrachlorodibenzo-*p*-dioxin (TCDD), which was present in concentrations near the detection limit, well below the proposed EPA standard of 30 ng/dscm.

The highest measured emission rate of PCBs from the JACADS stack during the DFS trial burns was 5.6×10^{-4} g/hr (2×10^{-5} oz/hr) (SRI 1990). Table C.3 provides a comparison of these PCB emissions with three of the largest commercial, EPA-permitted PCB incinerators in the continental United States (CONUS). The PCB emissions monitored from the JACADS DFS were significantly lower than permitted CONUS PCB incinerators.

Table C.3. Comparison of polychlorinated biphenyl (PCB) emissions from the Johnston Atoll Chemical Agent Disposal System (JACADS) with PCB emissions from three commercial PCB incinerators permitted by the Environmental Protection Agency

Incinerator[a]	PCB emission rate
Rollins	0.0181 g/hr (calculated—low value)
ENSCO	0.0548 g/hr (calculated—low value)
SCA	0.0630 g/hr (measured—low value)
JACADS Deactivation Furnace System	0.00056 g/hr (measured—high value)

[a]Rollins = Rollins Environmental Services, Inc., Deer Park, Tx.; ENSCO = Energy Systems Company, El Dorado, Ark.; SCA = SCA Chemical Services, Inc., South Chicago, Ill.

Source: Phase 2, Hazardous Waste Study No. 37-26-1345-86, Assessment of the Occupational Health, Environmental and Regulatory Impact of Polychlorinated Biphenyls Contained in the M441 Shipping and Firing Tube, Chemical Agent Munitions Disposal System, Tooele Army Depot, Tooele, Utah, 17–28 March 1986, U.S. Army, Aberdeen Proving Ground, Md., 1986.

C.2.1.2 RCRA trial burns with chemical agents

RCRA trial burns were conducted at JACADS as part of the operational verification testing (OVT) at that facility. The RCRA trial burns were conducted during incineration operations with actual chemical agents. Stack-gases were monitored from the liquid incinerator (LIC), the DFS, and the metal parts furnace (MPF). The list of air pollutants monitored included over 100 target analytes, depending upon the type of agent being burned. These pollutants may be organized into five broad categories: (1) volatile products of incomplete combustion (PICs), (2) semivolatile PICs, (3) polychlorinated dibenzo-*p*-dioxins and dibenzo furans, (4) metals, and (5) other miscellaneous pollutants, including mustard agent and hydrogen chloride.

Emission standards for agents GB, VX, and HD and other pollutants, such as dioxins and hydrogen chloride, as well as air quality standards for the public and workers are provided in Tables C.4 and C.5. Table C.6 provides a summary of JACADS monitoring data for pollutants of major interest. These data were collected during the RCRA and TSCA trial burns using actual chemical agents as the feed materials (AEHA 1992; SRI 1991, 1992a,b; UEC 1992, 1993).

Air emissions of chemical agents. No agent was detected in the exhaust stack during the RCRA and TSCA trial burns. DREs for the LIC were greater than 99.99999% for agents GB and VX, and greater than 99.9999% for agent HD. Feedstock for the MPF contained sufficiently small amounts of agent HD that no agent could be detected in the stack. Nevertheless, from the quantities fed into the MPF and from the stack gas detection limits for agent HD, it was possible to calculate that the DRE was greater than 99.9995%.

Table C.4. Air emission standards applicable to Johnston Atoll Chemical Agent Disposal System

	Standard[a]	
	Stack gas concentration	Destruction & removal efficiency
Agent GB	300 ng/m^3 [a]	99.99% [b]
Agent VX	300 ng/m^3 [a]	99.99% [b]
Agent HD	30,000 ng/m^3 [a]	99.99% [b]
Polychlorinated biphenyls (PCBs)		99.9999% [c]
Nitroglycerin		99.99% [b]
Dioxins/furans	30 ng/dscm [d]	
Hydrogen chloride		99% [e, f]
Particulate matter	180 mg/dscm [e]	

[a] *Federal Register* 53:8504–8507 (Mar. 15, 1988)
[b] Resource Conservation and Recovery Act (RCRA) permits
[c] Toxic Substances Control Act (TSCA) limit.
[d] *Federal Register* 56:5490 (Feb. 11, 1991); 40 CFR 60:53a (July 1, 1992) (standard for total dioxins/furans from large municipal waste combustors for which construction began after Dec. 20, 1989)
[e] 40 CFR 264.343 (July 1, 1992)
[f] Standard is the larger of 1.8 kg/hr or 99% removal efficiency.

Table C.5. Permitted concentrations of air pollutants in the vicinity of workers and ambient air quality standards for the general public

	Workers		General public	
Pollutant	Standard	Averaging period	Standard	Averaging period
Agent GB	0.1 μg/m^3 [a]	8 hr	3 ng/m^3 [a]	72 hr
Agent VX	0.01 μg/m^3 [a]	8 hr	3 ng/m^3 [a]	72 hr
Agent HD	3 μg/m^3 [a]		100 ng/m^3 [a]	72 hr
Polychlorinated biphenyls (PCBs)				
54% chlorine	500 μg/m^3 [b]	8 hr		
42% chlorine	1000 μg/m^3 [b]	8 hr		
Hydrogen chloride	7,000 μg/m^3 [b]	8 hr		
Sulfur dioxide	13,100 μg/m^3 (5 ppm) [b]	8 hr	80 μg/m^3 [c, d] 365 μg/m^3 [c, d] 1300 μg/m^3 [c, e]	annual 24 hr 3 hr
Nitrogen dioxide	9,400 μg/m^3 (5 ppm) [b]	8 hr	100 μg/m^3 [c]	annual
Carbon monoxide	55,000 μg/m^3 (50 ppm) [b]	8 hr	10,000 μg/m^3 [c] 40,000 μg/m^3 [c]	8 hr 1 hr
Particulate matter (PM_{10})	[f]		50 μg/m^3 [c, g] 150 μg/m^3 [c, d, g]	annual 24 hr
Ozone			235 μg/m^3 [c, d]	1 hr
Lead			1.5 μg/m^3 [c]	3-month [h]

[a] *Federal Register* **53**:8504–8507 (Mar. 15, 1988).

[b] 29 CFR 1910 (July 1, 1992); updated per *Federal Register* **58**:35338–35351 (June 30, 1993).

[c] National Ambient Air Quality Standards; 40 CFR 50.

[d] Not to be exceeded more than once per year (for ozone and PM_{10}, on more than one day per year on the average over 3 yr).

[e] This is a secondary standard only. Primary standards are set to protect public health; secondary standards are set to protect public welfare by protecting such things as plants, animals, soils, water, materials, and structures. Most of the standards given above are primary. In many of these cases, secondary standards exist, and they are the same as the primary standards. The 3-hr standard for sulfur dioxide is the exception.

[f] Worker exposures to general particulate matter are not regulated; however, certain types of dust (e.g., cotton dust) are regulated. Also, the American Conference of Government Industrial Hygienists recommends an upper limit of 10 mg/m^3 for an 8-hr concentration of particles not otherwise classified and which contain no asbestos less than 1% crystalline silicia (*Threshold Limit Values and Biological Exposure Indices for 1989–1990*, American Conference of Industrial Hygienists, Cincinnati, 1989.)

[g] The regulation applies to particulate matter that is small enough to pass easily into the lower respiratory tract (less than 10 μm in aerodynamic diameter, and therefore often designated PM_{10}).

[h] Calendar quarter.

Table C.6. Monitoring results during the first three Operational Verification Testing campaigns at Johnston Atoll Chemical Agent Disposal System [a]
[Values given represent the highest concentration or lowest destruction and removal from multiple runs during operational verification testing]

	OVT1 (GB)	OVT2 (VX)		OVT3 (HD)	
Pollutant	LIC	LIC	DFS	LIC	MPF
Agent					
Max. conc.	ND	ND	ND	ND	ND
Min. DRE	>99.999997%	99.999999 %	NC [b]	>99.99995%	>99.9996% [c]
Max. PCDD/PCDF conc.	0.16 ng/dscm	ND	769 pg/dscm [d]	1.08 ng/dscm	1.48 ng/dscm
Max. HCl emission rate	0.035 lb/hr	ND [e]	ND [e]	0.02 lb/hr	0.0497 lb/hr
Max. particulate conc. (@7% O_2)	4.23 mg/dscm	19.1 mg/dscm	4.6 mg/dscm	3.22 mg/dscm	10.92 mg/dscm
Max. CO conc. (@7% O_2)	26 ppm			18.5 mg/m^3	13.0 ppm
Max. lead conc.	16 µg/dscm		55 µg/dscm [d]		
PCBs					
Max. conc.			26 ng/dscm [d]		
Min. DRE			99.99990%		
Nitroglycerin					
Max. conc.			40 µg/dscm [e]		
Min. DRE			99.99884%		

[a] OVT-operational verification testing; ND-not detected; NC-not calculated; DRE-destruction and removal efficiency; PCDD/PCDF-polychlorinated dibenzo-*p*-dioxins/ polychlorinated dibenzofurans; HCl-hydrogen chloride; CO-carbon monoxide; PCBs-polychlorinated biphenyls.

[b] Agent is not fed to DFS.

[c] Proven efficiency is limited by the detection limit for stack gas and the amount of agent in the feed material. The amount of agent in the feed material in this case was very low. It should therefore be emphasized that this figure is a lower bound that was calculated using the detection limit as the assumed stack gas concentration, and no agent was actually detected in the stack gas.

[d] Maximum ambient air concentrations calculated using average Johnston Island meteorological conditions are 43.5 fg/m^3 (PCDD/PCDF), 2.8 ng/m^3 (lead), 1.3 pg/m^3 (PCBs), and 2.1 ng/m^3 (nitroglycerin). To get concentrations for worst-case meteorology, multiply by 1.7.

[e] Detection limit is 0.03 lb/hr (0.014 kg/hr).

Sources: Results of the RCRA Trial Burn with GB Feed for the Liquid Incinerator at the Johnston Atoll Chemical Agent Disposal System, SRI-APC-91-190-6967-006-F-R4, Southern Research Institute, Birmingham, Ala., 1991; *Results of the RCRA Trial Burn with VX Feed for the Liquid Incinerator at the Johnston Atoll Chemical Agent Disposal System*, SRI-APC-92-384-7530.5.1-I-R3, Southern Research Institute, Birmingham, Ala., 1992; *Results of the RCRA Trial Burn and the TSCA Demonstration Burn of the Deactivation Furnace System with M55 VX Rockets at the Johnston Atoll Chemical Agent Disposal System*, Final Report SRI-APC-92-385-7530.5.1-I-R3, Southern Research Institute, Birmingham, Ala., 1992; and *Inhalation Risk from Incinerator Combustion Byproducts, Johnston Atoll Chemical Agent Disposal System, Health Risk Assessment No. 42-21-MQ49-92*, U.S. Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md., 1992.; *Results of the Demonstration Test Burn for the Thermal Destruction of Agent HD in the Johnston Atoll Chemical Agent Disposal System Liquid Incinerator*, United Engineers and Constructors, Philadelphia, Pa., 1993.; and *RCRA Trial Burn Report for HD—Mustard Ton Containers—Metal Parts Furnace at the Johnston Atoll Chemical Agent Disposal System*, United Engineers and Constructors, Philadelphia, Pa., 1992.

Emissions of criteria pollutants. As discussed in Chapter 3, National Ambient Air Quality Standards (NAAQS) exist for SO_2, NO_2, O_3, carbon monoxide (CO), lead, and particulate matter in two size classes (less than or equal to 10 micrometers in aerodynamic diameter, PM_{10}, and less than or equal to 2.5 micrometers in aerodynamic diameter, $PM_{2.5}$). Lead is included in the NAAQS, but it is also regulated under RCRA, and is discussed separately in the following material.

Although NAAQS do not apply to Johnston Island, they do apply in the continental United States; therefore, SO_2, NO_2, CO, and PM_{10}, as well as lead, were monitored during the trial burns. The NAAQS for $PM_{2.5}$ became effective after the trial burns; therefore, $PM_{2.5}$ was not monitored. Ozone is formed by time-consuming chemical reactions which mostly occur long after the necessary chemical ingredients have left the stack; therefore, ozone was not monitored in the stack gases.

Stack concentrations were generally below 1.3 g/m^3 for SO_2 and below 0.94 g/m^3 for NO_x (conservatively assumed to consist entirely of NO_2). Assuming that concentrations are diluted by a factor of 10,000 between the stack and the ambient air,[1] the maximum hourly ambient air concentrations are 131 μg/m^3 for SO_2 and 94 μg/m^3 for NO_x. For SO_2, the NAAQS that corresponds most closely to an hourly average is a 3-hr average standard of 1300 μg/m^3, or about 10 times the maximum hourly average obtained above. A 3-hr average, which is always equal to or less than the maximum hourly average, would therefore be expected to be, at most, about 10% of the corresponding NAAQS. The only standard for NO_x is an annual average concentration of 100 μg/m^3. The annual average concentration would be expected to be less than one-tenth of the 94-μg/m^3 maximum permissible hourly concentration at locations in the continental United States. The standards for SO_2 and NO_x should not be exceeded as a result of incineration of chemical agent.

Other non-agent air emissions. During the DFS trial burns, the average DRE for PCBs was greater than 99.9999%, meeting the TSCA standard. The DRE of nitroglycerin in the DFS always exceeded 99.99%, as required by RCRA. Stack-gas concentrations of total dioxins and furans from the LIC ranged from undetectable to 1.48 ng/m^3. No TCDD (considered the most toxic form of dioxin) was detected in the LIC stack.

Stack gas concentrations of hydrogen chloride were within regulatory limits during the trial burns. Atmospheric emissions of target metals, including lead, were also measured during the OVT campaigns; the metals emissions were either not detectable or were below EPA's established levels of concern.

In 1999, a trial burn of 4.2-inch HD mortar rounds was conducted at JACADS to show compliance with the operating permit of the MPF, which allows for the destruction of agent residue within the munitions, as well as agent-contaminated materials (JACADS 1999). Of all the chemicals of concern that were measured at the stack, only mercury was found to be near or above the emission standards that were in the process of being finalized when the trial burns took place. Stack-gas concentrations of mercury as high as 142 μg/dscm were detected, even though mercury was not detected in the feed samples. The stack gas emissions standard for mercury is 45 μg/dscm (*NESHAPS: Final Standards for Hazardous Air Pollutants for Hazardous Waste Combustors,* 64 FR 52827, September 30, 1999). Any chemical weapons

---

[1]Conservative values of dilution factors were obtained from the EPA screening model SCREEN2, using design stack parameters typical of those for the exhaust stacks. The calculated dilution factor was 0.0008 at 1500 m from the stack (a typical distance from a proposed stack location to the nearest site boundary at U.S. storage depots).

incinerator constructed and operated in the United States will be required to meet the new standards for mercury, dioxins/furans, particulate matter, semivolatile metals, low volatile metals, hydrochloric acid/chlorine gas, hydrocarbons and destruction and removal efficiency for each specific principal organic hazardous constituent. The Army plans to employ enhanced monitoring, design changes, and operational modifications as necessary to maintain the mercury emission rate below these standards.

C.2.2 Incidents and Releases from JACADS

Because the Johnston Island facility serves as the pilot facility for chemical stockpile incineration, accidents and unexpected occurrences are reported, investigated, and analyzed. The investigations are directed to minimizing operational and environmental impacts. Corrective measures are implemented when appropriate.

The Army Program Manager for Chemical Demilitarization (PMCD) has an aggressive accident reporting procedure (PMCD 1994a). The chemical disposal facility operating contractor reports all accidents to the PMCD through the PMCD Field Office. PMCD notifies the Office of the Assistant Secretary of the Army (Installations, Logistics, and Environment), the Office of the Assistant Secretary of the Army (Research, Development and Acquisition), Department of the Army Safety Office, Deputy Chief of Staff for Operations and Plans, and DHHS. If there is a release of agent to the environment, then the procedures for reporting releases to EPA are also implemented.

C.2.2.1 Accidental releases of chemical agent from JACADS

During JACADS operation, there have been three confirmed chemical agent releases from the facility to the environment; the first two releases occurred during periods of equipment maintenance. These three releases occurred while working with nerve agent GB: (1) from the LIC through the PAS and out of the common stack on December 8, 1990, (2) from the LIC through the PAS and out of the common stack on March 23, 1994, and (3) from a charcoal filter unit supporting the Munitions Demilitarization Building (MDB) on March 17, 1995. In each case, an investigation was followed by recommendations for implementing corrective actions (see MITRE 1991, PMCD 1995a, PMCD 1994b, and PMCD 1995b).

C.2.2.2 Other incidents at JACADS

Other unplanned events, which released no agent to the environment, have occurred during JACADS operations. Public concern about these incidents has focused on releases of agent internal to the JACADS facility (Costner 1993a), false-positive monitoring alarms (Costner 1993b), and unintended detonations/fires of munitions during the demilitarization process. None of these incidents jeopardized the health and safety of personnel outside of the JACADS facility. In all cases, the redundancy (e.g., multiple layers of containment, cascading ventilation pathways) designed into the JACADS facility functioned as planned to prevent the release of chemical agent from the facility.

Two serious incidents, involving one injury and one fatality, at JACADS are described below. On March 17, 1993, eight people, in Toxicological Agent Protective Level B clothing, entered JACADS to carry bagged contaminated material from the second floor munitions corridor to the first floor Toxic Maintenance Area (CMDA 1993). The plastic bags contained mustard sludge removed from 105-mm projectiles. One individual on the entry team slung a bag over his shoulder to carry the 23-27 kg (40-60 lb) bag more easily. The slung bag was observed to be leaking liquid onto the back of the worker's calves while he carried it. The monitors did not detect agent contamination during the egress procedure, but the individual observed a 2.5 × 1.2 cm blister on the back of his right calf when reporting to work on the next operating shift. The blister was diagnosed by clinical examination and testing as a minor exposure to mustard. The individual was not physically impaired and was able to perform work in a "light duty" status. In response to the incident, the investigation team recommended corrective actions concerning bagging/containerizing of agent contaminated waste, protective clothing requirements, waste handling procedures, and egress monitoring procedures.

On October 30, 1997, the Army announced that the JACADS's employees had worked more than 3.5 million hours without a lost-time injury. The JACADS accident-free period was broken on November 27, 1997, when a contractor employee was killed while performing planned maintenance during an extended facility shutdown. The employee was servicing a large feed chute when an overhead portion of the chute fell on him. Neither chemical agent nor explosives were involved in the accident (Smart 1998).

C.3 EXPERIENCE IN DESTRUCTION OPERATIONS WITH THE TOOELE CHEMICAL AGENT DISPOSAL FACILITY

In September 1989, the systems contract for the construction and operation of the TOCDF in Tooele, Utah, was awarded to EG&G, Inc., of Falls Church, Virginia. The Tooele facility was the first of eight such facilities initially proposed for construction and operation under the CSDP. Construction of TOCDF was completed in August 1993.

After systemization of the facility, the state of Utah issued final permits and approval for the trial burn in June 1996. Destruction of chemical agents and munitions began at TOCDF on August 22, 1996. Lessons learned during the construction, systemization, and operation of the TOCDF will be applied to the CSDP disposal facilities proposed at other CONUS sites.

The shakedown process began with GB-filled M55 rockets and was followed by GB ton containers. Simultaneous co-processing of both munition types began on March 22, 1997. Processing of the rockets was halted in March 1997 at the end of the trial burns. During the analysis of the DFS trial burn, unanticipated low levels of PCBs were found in the Pollution Abatement System (PAS). Investigation later showed that gaskets in the PAS, not the rockets, was the source of the problem (TOCDF 1998). Corrective measures were taken, and processing of rockets was resumed.

C.3.1 Emission and Performance Data from Tests at TOCDF

Trial burns to establish that TOCDF could meet the TSCA and RCRA requirements were required before TOCDF could begin full operation. Individual incinerators have been brought on line, with the priority given to those needed to destroy the agent and munitions presenting the greatest storage hazard. (The stockpile of GB-filled M55 rockets and ton containers of GB is being destroyed first to produce the greatest reduction in the risk of storage.) Results of the TSCA burn for the DFS (EG&G 1997b, 1999), and the RCRA trial burns with agent GB for the MPF, LIC-1, LIC-2, and DFS are now available (EG&G 1997a, 1998a,b, 1999). The LIC-1, LIC-2, and MPF trial burns have been approved. Because of an equipment problem that might affect the reliability of the data needed for the health risk assessment (TOCDF 1998), the DFS trial burn was repeated in November 1998 (EG&G 1999). Additional trial burns will be conducted with other agents before the destruction campaigns for those agents are initiated.

C.3.1.1 TSCA trial burns

The TSCA test burn was conducted using the DFS in January 1997. This test, conducted by TRC Environmental Corp. for EG&G Defense Materials, Inc., was to demonstrate the capability to incinerate the PCBs found in the M55 rocket shipping and firing tubes. The DFS successfully had previously demonstrated a 99.999947% DRE for PCBs in a "mini-burn" in November 1996 (PMCD 1996). PCB DREs were greater than the required 99.9999% in all three 1997 test runs (EG&G 1997b). The TSCA performance of the DFS was confirmed during the repeat trial burn (see Table C.7). The minimum PCB DRE was 99.999985%. The maximum PCB emission rate, 1.0×10^{-8} g/s or 0.00028 g/hr, is well below that from the commercial PCB incinerators shown earlier in Table C.3. All the measured emissions were below regulatory limits, and the incinerator performance exceeded the requirements (EG&G 1999).

C.3.1.2 RCRA trial burns with chemical agents

Deactivation furnace system. The first agent trial burns with the DFS were also conducted in January 1997. Although the agent is drained from the rockets before they enter the DFS, there is enough residual agent to require that agent destruction be demonstrated. The PCBs in the rocket shipping and firing tubes required that PCB destruction also be demonstrated.

Table C.8 summarizes the results of the agent trial burns for the DFS, LIC-1, and MPF. Note that Table C.8 displays the poorest result from the three runs in each trial burn. Emissions of GB, CO, HCl, and particulates were well within the Utah permit limits. Agent destruction exceeded the RCRA requirement of 99.9999%, with 99.9999972% (EG&G 1999).

Liquid incinerator system 1. The agent trial burn for LIC-1 was conducted in February 1997 to demonstrate the ability to destroy agent GB in compliance with the Utah permit and RCRA regulations. Results of this trial are also found in Table C.8. The minimum DRE for GB from the three runs was 99.99999968%. Emissions of GB, CO, HCl, and particulates were within the established limits (EG&G 1998a).

Liquid incinerator system 2. The agent GB trial burns in the LIC-2 took place in August 1997. The results of the LIC-2 trial burns are summarized in Table C.8. The LIC-2 also exceeded the 99.9999% minimum DRE for agent GB, with a minimum DRE greater than 99.999999973%. The maximum concentrations of GB, particulate matter, and CO were well below the Utah permit limits, as was the maximum HCL emission rate (EC&G 1998b).

Metal parts furnace. In April 1997, EG&G conducted the agent trial burn for the MPF. This trial burn was conducted to demonstrate the required DRE for GB, and to demonstrate system performance with respect to compliance parameters, and the ability to control emissions regardless of munition type. Metals were added to the feed materials to represent the maximum feed rates of munitions containing heavy metals.

Table C.7. Emission and TSCA performance data[a] from the DFS second trial burn at TOCDF

	Regulatory limit/ comparison value	Average of three runs	Maximum. or minimum value
Exhaust gas emissions			
PCB emission rate	5.39×10^{-7} g/s[b]	8.97×10^{-9} g/s	1.0×10^{-8} g/s
PCDD/PCDF emission rate	5.65×10^{-9} g/s[b]	5.8×10^{-11} g/s	6.0×10^{-11} g/s
Particulate matter emission rate	0.0174 g/s[b]	0.0092 g/s	0.0121 g/s
Particulate concentration (@ 7% O_2)	48.3 mg/dscm[c] 180 mg/dscm[d, e]	2.9 mg/dscm	3.8 mg/dscm
HCl emission rate	4 lb/hr or 1% total HCl prior to PAS[c,d]	0.015 lb/hr	0.0158 lb/hr
NO_x concentration		314.2 ppm	353.3 ppm
CO concentration (@ 7% O_2)	100 ppm[e]	6.5 ppm	7 ppm
CO_2 concentration		6.90% dry	7.1% dry
Minimum DRE for PCBs and energetic components			
PCB DRE	99.9999%[d]	99.999985%	99.999984%
Nitroglycerine	99.99%[f]	99.99988%	99.99986%
3,4,6-trinitrotoluene (TNT)	99.99%[g]	99.99989%	99.99987%
Incinerator performance standards			
Afterburner combustion efficiency	99.9%[d]	99.99%	99.99
Afterburner residence time	>2 s[d, e]	3.1 s	2.5S
Afterburner exhaust gas temperature	>2000 °F[d] 2050<T<2350 °F[e]	2150 °F	2143–2159 °F

[a] Data from *Tooele Chemical Agent Disposal Facility (TOCDF), RCRA Agent GB Trial Burn #2 Report for the Deactivation Furnace System*, rev. 0, EG&G Defense Materials, Inc., Tooele, Utah, Feb. 16, 1999, Table 1-1, p. 4 (CO, DREs); Table 3-1, pp. 23–24 (CO, afterburner data), Table 5-4, p. 45 (particulates, CO_2); Table 5-5, p. 46 (HCl); Table 5-11, p. 45 (PCB); Table 5-14, p. 69 (PCDD/PCDF); Table 5-25, p. 93 (NO_x); Table 7-2, p. 110 (PCB DRE); Table 7-3, p. 111 (nitroglycerin, TNT DRE).

[b] Values used in *Tooele Chemical Demilitarization Facility Tooele Army Depot South (EPA I.D. No. UT5210090002), Screening Risk Assessment*, A.T. Kearny, Inc., San Francisco, prepared for State of Utah Department of Environmental Quality, Division of Solid and Hazardous Waste, Salt Lake City, February 1996, Appendix R.

[c] Limit set by Air Approval Order.

[d] Limit set by TSCA.

[e] Limit set by RCRA Permit.

[f] Value set by DFS GB ATB Plan.

Table C.8. Summary of TOCDF RCRA agent GB trial burn reports

	Utah Permit Limit	Trial Burn			
		DFS	LIC-1	LIC-2	MPF
Max. GB concentration [a,b]	0.3 μg/m^3	<0.0028 μg/m^3	<0.0034 μg/m^3	<0.0034 μg/m^3	<0.0046 μg/m^3
Min. GB DRE[b]	99.9999%	>99.9999972%	>99.999999968%	>99.999999972%	>99.99999972%
Max. particulate matter concentration (@ 7% O_2) [c]	48.3 mg/dscm [d] 180 mg/dscm [d]	3.8 mg/dscm	5.3 mg/dscm	4.8 mg/dscm	22.3 mg/dscm
Max. HCl emission rate	4 lb/hr [e]	0.016 lb/hr	0.037 lb/hr	<0.008 lb/hr	<0.015 lb/hr
Max. CO concentration (@ 7% O_2)[f]	100 ppm	7 ppm	74 ppm	50 ppm	12 ppm
Max. dioxin TEQ concentration (@ 7% O_2) [b,g]	<0.2 ng/dscm	<0.0036 ng/dscm		<0.00093 ng/dscm	<0.042 ng/dscm
Max. TEQ emission rate[b,g]		$<1.2 \times 10^{-11}$ g/s	$<3.6 \times 10^{-11}$ g/s[h]	$<5.6 \times 10^{-11}$ g/s [h]	5.7×10^{-11} g/s
Max. total PCDD/PCDF emission rate[b,g]		$<6.0 \times 10^{-11}$ g/s	$<2.0 \times 10^{-10}$ g/s	$<2.9 \times 10^{-10}$ g/s	$<4.4 \times 10^{-9}$ g/s

[a] From analysis of DAAMS sorbent tubes—Station PAS 702 (DFS), Station PAS 704 (LIC-1), Station PAS 705 (LIC-2), Station PAS 703 (MPF).
[b] Maximum concentration or minimum DRE of results for three runs. Limit of quantification value was used because no GB was detected.
[c] Equivalent values in gr/dscf @ 7% O_2: DFS, 0.0017; LIC-1, 0.0023; LIC-2, 0.0016; and MPF, 0.0097.
[d] Smaller limit set by Air Approval Order, equivalent to 0.016 gr/dscf @ 7% O_2; larger limit set by RCRA Permit, equivalent to 0.08 gr/dscf @ 7% O_2.
[e] Alternatively 1% total prior to PAS (LIC-1 and DFS reports) or 1% total organochlorine (MFP report).
[f] Maximum value from 60 min rolling average.
[g] Maximum value calculated from method detection limits.
[h] Calculated from max. PCDD/PCDF emission rates in Table 5-16, p. 72, LIC-1 report; Table 5-16, p. 70, LIC-2 report; and TEF values (App. C, Sect. C-23).

Sources: Compiled from *Tooele Chemical Agent Disposal Facility (TOCDF), RCRA Agent GB Trial Burn #2 Report for the Deactivation Furnace System*, rev. 0, EG&G Defense Materials, Inc., Tooele, Utah, Feb. 16, 1999, (Table 1-1, p. 4; Table 5.4, p. 44; Table 7-1, p. 108); *Tooele Chemical Agent Disposal Facility (TOCDF) RCRA Agent GB Trial Burn Report for the Liquid Incinerator System #1*, rev. 2, EG&G Defense Materials, Inc., Tooele, Utah, July 15, 1998 (Table 1-1, p. 2; Table 5-4, p. 43; and Table 5-16, p. 72); *Tooele Chemical Agent Disposal Facility (TOCDF) RCRA Agent GB Trial Burn Report for the Liquid Incinerator System #2*, rev. 1, EG&G Defense Materials, Inc., Tooele, Utah, June 19, 1998 (Table 1-1, p. 3; Table 5-4, p. 42; and Table 5-16, p. 70); and *Tooele Chemical Agent Disposal Facility (TOCDF) RCRA Agent GB Trial Burn Report for the Metal Parts Furnace*, rev. 0, EG&G Defense Materials, Inc., Tooele, Utah, Aug. 15, 1997 (Table 1-1, p. 3; Table 5-4, p. 42; and Table 5-15, p. 69). TEQ emission/concentration data for DFS from M. J. Rowe and T. A. Ryba, Jr., PMCD, U.S. Army, Aberdeen Proving Ground, Md., letter to H. Dodohara, EPA, Washington, D.C., Feb. 26, 1998.

Results of the trial burn are summarized in Table C.8. Emissions of GB, CO, HCl, and particulates were within the established limits for the MPC. Emission of HCl were not detected; the given rate is the maximum calculated rate. Minimum DRE for GB was 99.99999972%, well above the required 99.9999% (EG&G 1997a).

C.3.2 Incidents and Releases from TOCDF Involving Agent GB

Some unexpected events or operational fluctuations occurred during the early TOCDF operations; investigation of these events has led to improvements in facility operation. These events are discussed below. The events have been grouped arbitrarily into those that involved detection of agent within the facility and other incidents. None of the incidents involved a release of agent outside the facility, and there was never a threat to the public or the environment.

MPF shutdown. The MPF shut down automatically on March 30, 1998, when an incompletely drained MC-1 bomb was fed into the incinerator. The excess GB remaining in the bomb was the result of an improperly positioned drain probe. The increased temperature due to the extra GB triggered automatic shutdown of the furnace. An ACAMS alarm in the MPF duct sounded during the incident, but this is thought to have been due to an interferent material. Neither ACAMS in the main stack alarmed, and no evidence of GB was found when the DAAMS tubes were analyzed (Bauman 1999a,b; DCD 1999) .

Agent spill. About 140 gallons of liquid GB was spilled from an agent strainer assembly on December 13, 1998. The strainer is designed to remove solids that might be present in the liquid agent before the agent is pumped to the LIC. The spill occurred in an environmentally controlled area of the facility, and the agent was captured in a sump designed for that purpose (Israelsen 1998; DCD 1998a). The cause of the spill was an incorrectly installed washer on the strainer assembly, which had been serviced before the incident. Maintenance procedures were revised to correct the problem, and destruction operations resumed on December 16. No employees were exposed to the agent, and no agent was released to the environment (DCD 1998b).

Worker actions. In April 1997, two incidents initiated by worker actions resulted in positive agent readings. On April 21, workers in Level B clothing opened a bag of inadequately labeled waste in the toxic maintenance area and triggered an abnormally high room alarm. On the following day, workers entered the Category A airlock and the toxic maintenance area without authorization, resulting in a 0.4 time-weighted average reading in the airlock (PM-CSD/EG&G 1997).

As a result of these actions, the Site Project Manager limited facility activities under a “Notice to Discontinue for Insufficient Quality” until additional management controls were instituted. The limitation was lifted on April 24, 1997. These incidents, as well as results from an audit of the Quality Assurance Plan Program in the areas of configuration control and criteria for entry-level employees, prompted a joint Program Manager for Chemical Stockpile Disposal-EG&G review (PMCD 1997; DCD 1997). Their report (PM-CSD/EG&G 1997) focused on staff and management issues and made recommendations for improvements.

Agent detection during unpacking and inspections. Small quantities of agent GB have been detected a number of times during routine monitoring of the interior air of onsite containers (ONCs), used to transport the munitions to the processing facility. The agent was being contained within the identified ONCs until they were unloaded in a controlled area of the facility by workers dressed in protective clothing. Numerous small leaks of GB have been detected recently during the processing of the 105-mm projectiles; these leaks were found when the nose plugs were removed to verify that there was no explosive charge present. The inspections took place in an environmentally contained unpack area. The leaking projectiles were then processed through the incinerator. Although press releases have often been issued, detection of agent in these circumstances was not unexpected, due to the aging of the chemical agent stockpile. The environmental controls and protective clothing have prevented exposure of workers and releases to the environment.

C.4 PAST ASSESSMENTS OF CHEMICAL AGENT INCINERATION TECHNOLOGY

The JACADS experience has been assessed by both PMCD and independent organizations to draw some conclusions about the baseline incineration technology.

PMCD assessment. In 1996, PMCD assessed the JACADS experience (PMCD 1996). It concluded that the JACADS operational experience, though not flawless, has demonstrated that the baseline technology can safely and effectively destroy chemical agent, chemical-filled munitions and bulk chemical storage containers. During the first six years of operation, demilitarization has eliminated the entire stockpile of some munitions. There had been three low-level GB nerve agent releases to the atmosphere that did not pose a worker or public health risk, and there has been only one minor agent exposure to a worker. After detailed inspection- and analysis of relevant facts, PMCD felt that the claims from the opposition groups concerning the Army's inability to demonstrate that the chemical disposal facilities can operate without releasing large amounts of nerve agent to the environment and exposing workers to serious health risks is unsported.

The JACADS industrial accident rates had also been steadily improving since the start of JACADS. The industrial rates for Recordable Incident Rates (RIR) and Cases With Days Away (CWDA) were normally below the average rates for similar industries (CDRA 1995). The PMCD performed an operational readiness evaluation prior to starting agent destruction at JACADS (PMCD 1989). This survey included personnel from outside of the PMCD and from outside of the Department of the Army to add independent reviews of facility readiness. All of the findings identified during the surveys were tracked to completion and agent operations were not allowed to begin until all findings were resolved.

MITRE Corporation. The MITRE OVT Reports (1991, 1992, 1993a,b,c) include the following statement:

> "JACADS met the OVT safety performance goals that were established for it. As expected, there were no injuries or fatalities arising from the processing of agent or munitions. Events did occur that challenged the levels of protection designed into JACADS. While none of these presented (nor could have presented) significant public risk, some of the events increased the probability of agent exposure or injury to workers. The lack of agent or munition injury demonstrates the importance of having 'safety in depth' incorporated into the facility design and operation."

The National Research Council. Although the Johnston Island facility did experience numerous problems during OVT, the Stockpile Committee of the NRC concluded in 1994 that there were no “show stoppers” in these problems (NRC 1994b). The NRC also stated that no such system can be completely designed without problems, and the baseline system has been properly designed with multiple levels of safety to contain problems before they become hazards to the workers or surrounding communities (NRC 1994b).

The Henry L. Stimson Center. The Henry L. Stimson Center, a nonprofit, nonpartisan institution devoted to public policy research, published a report on the U.S. chemical weapons destruction program in 1994 (Smithson 1994). This report notes that the U.S. Army’s monitoring level for nerve agents is 21,000 times stricter than what would be required federally and about 210 times stricter than the tougher emissions standards requested by some states. For mustard, the Army’s monitoring levels are 415 times stricter than the federal requirement and four times stricter than the more rigorous state emissions standard. In addition, the Army’s incinerators have hundreds more operational checkpoint and safeguards than federal regulations require. These extra alarms give the Army ample information about the incinerator’s operation to enable appropriate adjustments to be made to maintain the highest level of combustion efficiency.

The Stimson Report provides a discussion on advocacy science concerning several of the opposition group reports. The Stimson Report includes a review of Greenpeace’s *Playing With Fire* (Costner and Thornton 1990). This review states that the Greenpeace report does not appear to have been subjected to the standard peer review process that the scientific community uses; the report omitted large amounts of scientific data that contradicts the data it presents or the conclusion reached; the authors use data selectively and misinterpret it; and authors use out-of-date information. EPA and other regulatory standards are based upon extensive, peer-reviewed research that draws upon all of the data and studies that Greenpeace and other incineration opponents fail to cite, as well as upon data provided by opposition scientists. To date, federal regulators have clearly stated that the Army’s program has met or exceeded these standards.

C.5 CONCLUSIONS REGARDING CHEMICAL AGENT INCINERATION TECHNOLOGY

The JACADS operational experience, as continued by the on-going destruction of chemical agents and munitions at TOCDF, has shown that the baseline incineration program can effectively destroy chemical weapons in a safe and environmentally protective manner. The JACADS facility destroyed over 4 million pounds of lethal chemical agent and over 410,000 items/munitions/rounds in its ten years of operation.

An additional 9.6 million pounds have been destroyed from August 1996 through November 2000 in the TOCDF facility in Utah. During JACADS operations, there were three confirmed minor agent releases from the facility to the environment, and several other operational malfunctions leading to fires or accidental detonations of munitions. The design of JACADS and the continually maturing PMCD safety culture insured that none of these processing incidents posed a threat to workers or to the population located near the facility. The safety and operational record of the Army's chemical weapons incinerators enhances the confidence placed in the baseline incineration system by the NRC and other reviewers.

C.6 REFERENCES

AEHA (U.S. Army Environmental Hygiene Agency) 1992. *Inhalation Risk From Incinerator Combustion Products, Johnston Atoll Chemical Agent Disposal System*, Health Risk Assessment No. 42-21-MQ49-92, Aberdeen Proving Ground, Md.

AEHA (U.S. Army Environmental Hygiene Agency) 1993a. *Inhalation Risk from Incinerator Combustion Products, Operational Verification Testing—Phase 1, Johnston Atoll Chemical Agent Disposal System*, Health Risk Assessment No. 42-21-M1BE-93, Aberdeen Proving Ground, Md.

AEHA (U.S. Army Environmental Hygiene Agency) 1993b. *Inhalation Risk from Incinerator Combustion Products, Operational Verification Testing—Phase 3 Johnston Atoll Chemical Agent Disposal System*, Health Risk Assessment No. 42-21-M1X6-93, Aberdeen Proving Ground, Md.

Bauman, J. 1999a. "Did Incinerator Allow Major Nerve-Gas Release?", *Deseret News*, Salt Lake City, Jan. 5, URL: http://www.desnews.com/cgi-bin/libstory_reg?dn99&9901050116 (accessed Mar. 31, 1999).

Bauman, J. 1999b. "Nerve Agent Wasn't Released at Tooele Incinerator, Army Says; Spokesman Says Unknown Material Set Off '98 Alarm," *Deseret News*, Salt Lake City, Jan. 12, URL: http://www.desnews.com/cgi-bin/libstory_reg?dn99&9901130374 (accessed Jan. 15, 1999).

CDRA (U.S. Army Chemical Demilitarization and Remediation Activity) 1995. *Comparison of Demilitarization and Industrial Occupational Injury Rates*, Aberdeen Proving Ground, Md., May.

CMDA (U.S. Army Chemical Materiel Destruction Agency) 1993. *Report of the 17 March 1993 Potential Mustard (HD) Exposure*, A04-0752.1, Aberdeen Proving Ground, Md.

Costner, P. 1993a. *The Army's Experience at Johnston Atoll Chemical Disposal System*, Washington, D.C., Greenpeace, April.

Costner, P. 1993b. *Chemical Weapons Demilitarization and Disposal: JACADS GB and VX Campaigns*, Greenpeace, Washington, D.C., May.

Costner, P., and J. Thornton 1990. *Playing with Fire: Hazardous Waste Incineration*, Greenpeace, Washington, D.C.

DCD (Deseret Chemical Depot) 1997. "TOCDF: Update," Press Release, Tooele, Ut., May 9, URL: http://www-pmcd.apgea.army.mil/news/pr05-09-97.html (accessed Aug. 26, 1997).

DCD (Deseret Chemical Depot) 1998a. "Agent Detected," Press Release, Tooele, Ut., Dec. 14, URL: http://www-pmcd.apgea.army.mil/text/CSDP/IP/PR/1998/199812/19981214b/index.html (accessed Mar. 31, 1999).

DCD (Deseret Chemical Depot) 1998b. "Spill Cause Determined; Chemical Weapons Disposal Operations Resumed," Press Release, Tooele, Ut., Dec. 16, URL: http://www-pmcd.apgea.army.mil/text/CSDP/IP/PR/1998/199812/19981216/index.html (accessed Mar. 31, 1999).

DCD (Deseret Chemical Depot) 1999. "Challenge of Chemical Weapons Working Group Lawyer's Reported Assertions of 'Major Nerve Gas Release'," Press Release, Tooele, Ut., Jan. 10, URL: http://www-pmcd.apgea.army.mil/text/CDSP/IP/PR/1999/199901/19990110/index.html (accessed Mar. 31, 1999).

EG&G (EG&G Defense Materials, Inc.) 1997a. *Tooele Chemical Agent Disposal Facility (TOCDF), RCRA Agent GB Trial Burn Report for the Metal Parts Furnace*, rev. 0, Tooele, Ut., Apr. 9.

EG&G (EG&G Defense Materials, Inc.) 1997b. *Tooele Chemical Agent Disposal Facility (TOCDF), TSCA Demonstration Test Burn Report for the Deactivation Furnace System*, rev. 0, Tooele, Ut., Apr. 24.

EG&G (EG&G Defense Materials, Inc.) 1998a. *Tooele Chemical Agent Disposal Facility (TOCDF), RCRA Agent GB Trial Burn Report for the Liquid Incinerator System #1*, rev. 2, Tooele, Ut., July 15.

EG&G (EG&G Defense Materials, Inc.) 1998b. *Tooele Chemical Agent Disposal Facility (TOCDF), RCRA Agent GB Trial Burn Report for the Liquid Incinerator System #2*, rev. 1, Tooele, Ut., June 19.

EG&G (EG&G Defense Materials, Inc.) 1999. *Tooele Chemical Agent Disposal Facility (TOCDF), RCRA Agent GB Trial Burn Report #2 for the Deactivation Furnace System (DFS),* rev. 0, Tooele, Ut., Feb. 16.

Israelsen, B. 1998. "Nerve Agent Spills from Army Machinery," *The Salt Lake Tribune*, Salt Lake City, Dec. 15, URL: http://www.sltrib.com/1998/dec/12151998/utah/utah.htm (accessed Dec. 16, 1998).

MITRE 1991. *Evaluation of the GB Rocket Campaign: Johnston Atoll Chemical Agent Disposal System Operational Verification Testing,* MTR-91W00039, The MITRE Corporation, McLean, Va.

MITRE 1992. *Evaluation of the VX Rocket Test: Johnston Atoll Chemical Agent Disposal System Operational Verification Testing*, MTR-92W0000064, The MITRE Corporation, McLean, Va.

MITRE 1993a. *Summary Evaluation of the Johnston Atoll Chemical Agent Disposal System: Operational Verification Testing*, MTR-93W0000036, The MITRE Corporation, McLean, Va.

MITRE 1993b. *Evaluation of the HD Ton Container Test: Johnston Atoll Chemical Agent Disposal System Operational Verification Testing*, MTR-93W0000002, The MITRE Corporation, McLean, Va.

MITRE 1993c. *Evaluation of the HD Projectile Test: Johnston Atoll Chemical Agent Disposal System Operational Verification Testing*, MTR-93W0000060, The MITRE Corporation, McLean, Va.

NRC (National Research Council) 1994a. *Review of Monitoring Activities Within the Army Chemical Stockpile Disposal Program*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1994b. *Evaluation of the Johnston Atoll Chemical Agent Disposal System Operational Verification Testing Part II*, National Academy Press, Washington, D.C.

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1989. *Johnston Atoll Chemical Agent Disposal Facility Operational Readiness Evaluation*, Aberdeen Proving Ground, Md., March.

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1990. *Johnston Atoll Chemical Agent Disposal Facility Operational Readiness Evaluation*, Aberdeen Proving Ground, Md., March.

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1994a. *Policy Statement No. 25 Accident Reporting, Investigating, and Records*, Aberdeen Proving Ground, Md., July.

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1994b. *Johnston Atoll Chemical Agent Disposal System (JACADS) Report of the 23 March 1994 Chemical Agent (GB) Release from the Common Stack*, Aberdeen Proving Ground, Md., March.

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1994c. *Johnston Atoll Chemical Agent Disposal System (JACADS) Report of the 19 November 1994 Explosive Containment Room (ECR) "B" Incident*, Aberdeen Proving Ground, Md., December.

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1995a. *Review of the Required Report for the Operational Verification Tests (September 1993)*, Programmatic Lessons Learned Consolidation Report #1, Aberdeen Proving Ground, Md., March.

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1995b. *Review of the Report of the 23 March 1994 Chemical Agent Release from the Common Stack*, Programmatic Lessons Learned Consolidation Report #1, Aberdeen Proving Ground, Md., March.

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1996. *Chemical Stockpile Disposal Program, Chemical Agent and Munitions Disposal Operations at Tooele, Utah: Evaluation of Information on Dioxin Emissions, Alternative Technologies and Baseline Incineration,* Aberdeen Proving Ground, Md., July.

PM-CSD/EG&G (Program Manager for Chemical Stockpile Disposal/EG&G) 1997. *Management Assessment Team Review of the Tooele Chemical Agent Disposal Facility, 13–21 May 1997*, Aberdeen Proving Ground, Md., URL: http://www-pmcd.apgea.army.mil/news/rptissue.html (accessed Sept. 22, 1997).

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1996. "Bi-weekly Update Number 5," Press Release 96-40, Aberdeen Proving Ground, Md., Dec. 20, URL: http://www-pmcd.apgea.army.mil/text/CSDP/IP/PR/1996/199612/19961220/index.html (accessed Mar. 30, 1999).

PMCD (U.S. Army Program Manager for Chemical Demilitarization) 1997. "TOCDF: Bi-weekly Update Number 14," Press Release 97-23, Aberdeen Proving Ground, Md., Apr. 24, URL: http://www-pmcd.apgea.army.mil/text/CSDP/IP/PR/1997/199704/19970424/index.html (accessed Mar. 31, 1999).

Smart, R. A. 1998. *Report of the 27 November 1997 Johnston Atoll Chemical Agent Disposal System (JACADS) Accident*, Program Manager for Chemcial Demilitarization, Aberdeen Proving Ground, Md.

Smithson, A. E. 1994. *The U.S. Chemical Weapons Destruction Program: Views, Analysis, and Recommendations*, Report No. 13, The Henry L. Stimson Center, September.

SRI (Southern Research Institute) 1990. *Results of the TSCA R&D Burns for the Deactivation Furnace System at the Johnston Atoll Chemical Agent Disposal System*, SRI-APC-90-412-6967-008-01, Southern Research Institute, Birmingham, Ala., prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

SRI (Southern Research Institute) 1991. *Results of the RCRA Trial Burn with GB Feed for the Liquid Incinerator at the Johnston Atoll Chemical Agent Disposal System*, SRI-APC-91-190-6967-006-F-R4, Southern Research Institute, Birmingham, Ala., prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

SRI (Southern Research Institute) 1992a. *Results of the RCRA Trial Burn with VX Feed for the Liquid Incinerator at the Johnston Atoll Chemical Agent Disposal System*, SRI-APC-92-384-7530.5.1-I-R3, Southern Research Institute, Birmingham, Ala., prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

SRI (Southern Research Institute) 1992b. *Results of the RCRA Trial Burn and the TSCA Demonstration Burn of the Deactivation Furnace System with M55 VX Rockets at the Johnston Atoll Chemical Agent Disposal System*, SRI-APC-92-385-7530.5.1-I-R3, Southern Research Institute, Birmingham, Ala., prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

TOCDF (Tooele Chemical Agent Disposal Facility) 1998. "M55 Rocket Trial Burn Tests," Press Release, Tooele, Ut., July 16, URL: http://www-pmcd.apgea.army.mil/text/CSDP/IP/PR/1998/199807/19980716/index.html (accessed Oct. 7, 1998).

UEC (United Engineers and Constructors) 1992. *RCRA Trial Burn Report for HD—Mustard Ton Containers—Metal Parts Furnace at the Johnston Atoll Chemical Agent Disposal System*, United Engineers and Constructors, Philadelphia, Pa., prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

UEC (United Engineers and Constructors) 1993. *Results of the Demonstration Test Burn for the Thermal Destruction of Agent HD in the Johnston Atoll Chemical Agent Disposal System Liquid Incinerator*, Report A04-0751.2, United Engineers and Constructors, Philadelphia, Pa., prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

U.S. Army 1988. *Chemical Stockpile Disposal Program, Final Programmatic Environmental Impact Statement*, Vols. 1, 2, and 3, Program Executive Officer—Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

APPENDIX D

INCINERATION TECHNOLOGY DESCRIPTIONS

D.1. BASELINE INCINERATION TECHNOLOGY

D.1.1 Existing Facilities and Proposed Changes

The baseline incineration technology is based on the systems being used in the Johnston Atoll Chemical Agent Disposal System (JACADS), which has completed destruction of chemical agents and munitions on Johnston Island in the Pacific Ocean, about 1,300 km (825 miles) southwest of Honolulu, Hawaii (U.S. Army 1983). The decision to destroy the chemical agent and munition stockpile by incineration was based on the maturity of the baseline process, the ability to perform operational testing with production-scale facilities at the JACADS plant, and safety and environmental considerations. The performance of the JACADS facility during Operational Verification Testing (OVT) and continuing operations and Tooele Chemical Disposal Facility (TOCDF) during systemization and operations will be reflected in the PCD design to minimize the risks of destruction operations. The JACADS plant is described in more detail in the FPEIS (U.S. Army 1988).

The baseline incineration destruction process (Fig. D.1), as constructed at JACADS and TOCDF, includes reverse assembly (i.e., disassembly of the chemical munitions) as well as agent destruction by incineration, incineration of components, and incineration of various wastes in four types of primary incinerators (furnaces): (1) a liquid incinerator (LIC)—a stationary liquid injection incinerator; (2) a deactivation furnace system (DFS)—a rotary kiln; (3) a metal parts furnace (MPF)—a roller hearth incinerator; and (4) a dunnage incinerator (DUN)—a stationary bed incinerator. Liquid chemical agent will be drained from munitions bodies and destroyed in the LIC. The LIC will also incinerate spent decontamination fluid. Energetic materials (explosives and propellants) will be segregated from munitions by reverse assembly procedures and destroyed in the DFS. Metal that has been in contact with chemical agent will be decontaminated in the MPF. If constructed, the DUN would be used to burn combustible nonmunition wastes and debris, such as packaging material. However, the DUN has been removed from service at JACADS and TOCDF because of operating difficulties. Combustible, agent–contaminated dunnage will be burned in the MPF or DFS. Uncontaminated dunnage will be sent to an appropriately permitted off-site disposal facility. All incinerators have secondary combustion chambers to destroy any agent not incinerated in the primary furnace. A pollution abatement system (PAS) for each incinerator will be used to control atmospheric emissions. At JACADS and TOCDF there is a brine reduction area (BRA) with its own PAS. The BRA is used to evaporate liquid effluents from the incinerators' PAS to dryness. However, the BRA has been removed from service at TOCDF because of cost constraints. Liquid effluents will be stored and disposed of at an off-site Resource Conservation and Recovery Act (RCRA) treatment, storage, and disposal facility (TSDF).

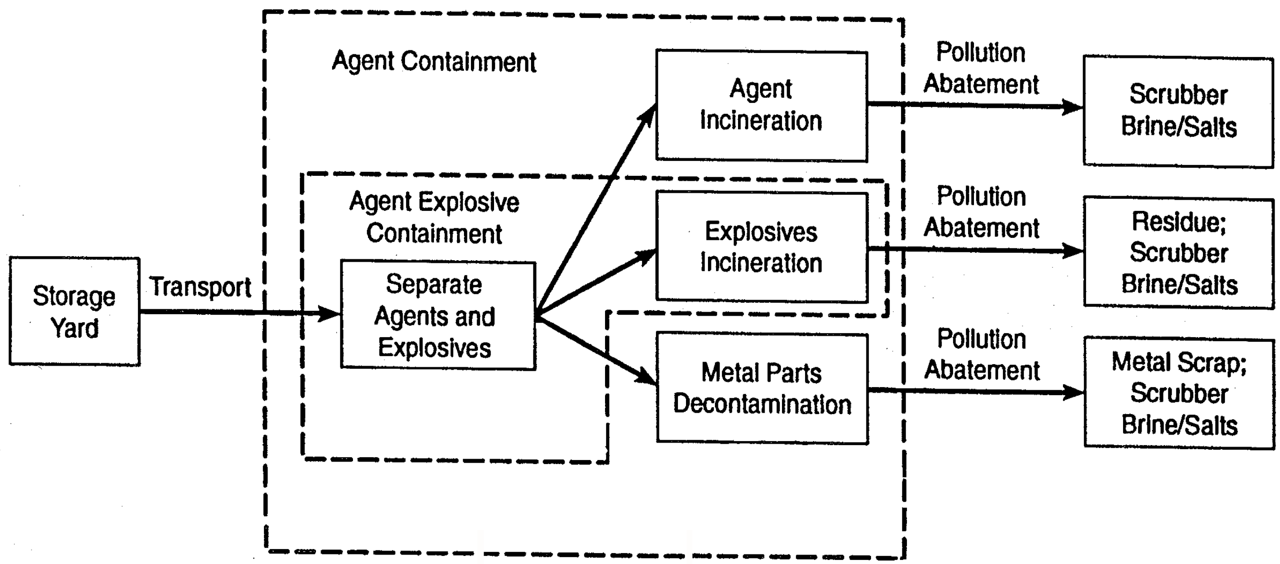


Fig. D.1. Schematic diagram of the baseline incineration process for the proposed Pueblo Chemical Agent Disposal Facility.

D.1.2 Facility Description

The baseline incineration facility for Pueblo Chemical Depot (PCD) would consist of three incinerators, described in Sect. D.1.1, housed within one building, pollution abatement equipment, and several support buildings constructed on an 8-ha (20-acre) site immediately adjacent to the existing chemical agent storage area.

D.1.2.1 Facility site

Areas A, B, and C considered for siting the destruction facility are shown in Fig. D.2 existing security fencing along the perimeter of the chemical agent storage area will be extended to include the proposed site, thereby creating a contiguous fenced area consisting of the storage area and the destruction site. On-post personnel not directly associated with demilitarization operations will be excluded from a buffer area around the destruction site or provision will be made for their protection or evacuation.

The area topography consists of nearly flat terrain with a maximum slope of 1.1°. Construction of the proposed destruction facility at PCD will involve small amounts of excavation and fill work. Leftover construction debris will be transported to a commercial disposal site.

The drainage system will be designed to divert surface runoff from the plant site and prevent erosion and surface water accumulation on the site. Minimal clearing, grubbing, and earthwork will be required because vegetation is sparse in this area and the land is relatively level.

D.1.2.2 Primary process and process-support buildings

The baseline PCD destruction facility includes a munitions demilitarization building (MDB), which will house the three incinerators; a PAS, an analytical laboratory, a personnel maintenance building (PMB), a process support building (PSB), a process utilities building (PUB), an entry control facility, and associated support facilities needed for operations and maintenance (Fig. D.3). A container handling building (CHB) has been constructed at TOCDF, but a CHB has been determined to be unnecessary at PCD. This is a conceptual design that is not final and will likely evolve further. The descriptions in this FEIS are based on the design criteria documents specific to PCD as well as 100% design for similar destruction facilities at JACADS and TOCDF. The heart of the destruction plant will be the MDB, a two-story building to house the three incinerators and mechanical processing equipment for preparing the munitions for incineration. The destruction process is described in Sect. D.1.3.

The MDB structure and ventilation are being designed to control hazardous materials and vapors within the building (see U.S. Army 1988). The process areas in the building will have a negative pressure with respect to the environment and will thus prevent the escape of vapors from the building. Different air-ventilation zones in the MDB will be established according to the degree of agent contamination and will be separated by physical barriers for agent confinement. Pressure differentials between zones will direct airflow from zones of lower potential for agent contamination to zones of higher potential (i.e., a cascading ventilation system). The building ventilation exhaust will be filtered through charcoal filters to remove agent before being discharged to the atmosphere.

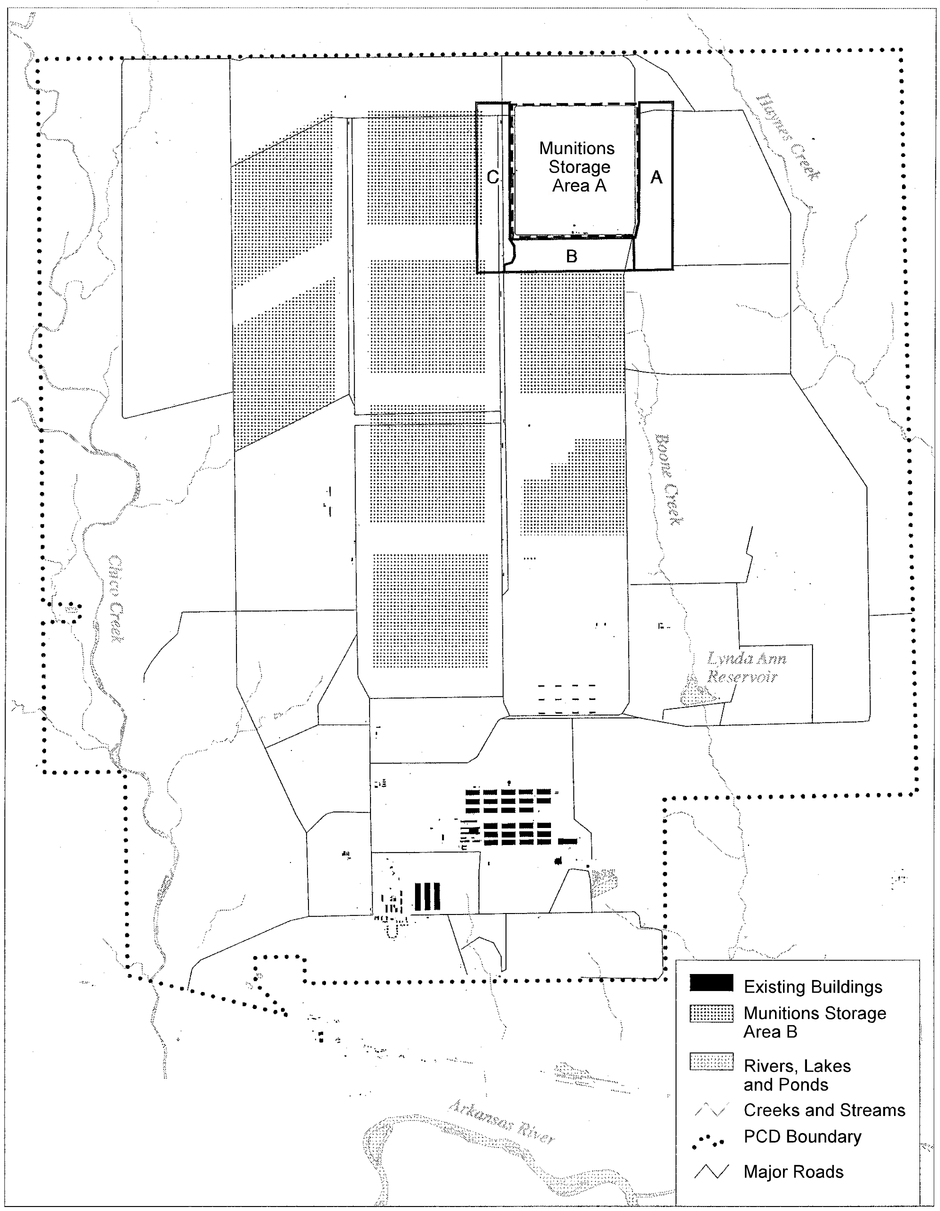


Figure D.2. Alternative facility locations (A, B, and C) for the proposed destruction facility at Pueblo Chemical Depot.

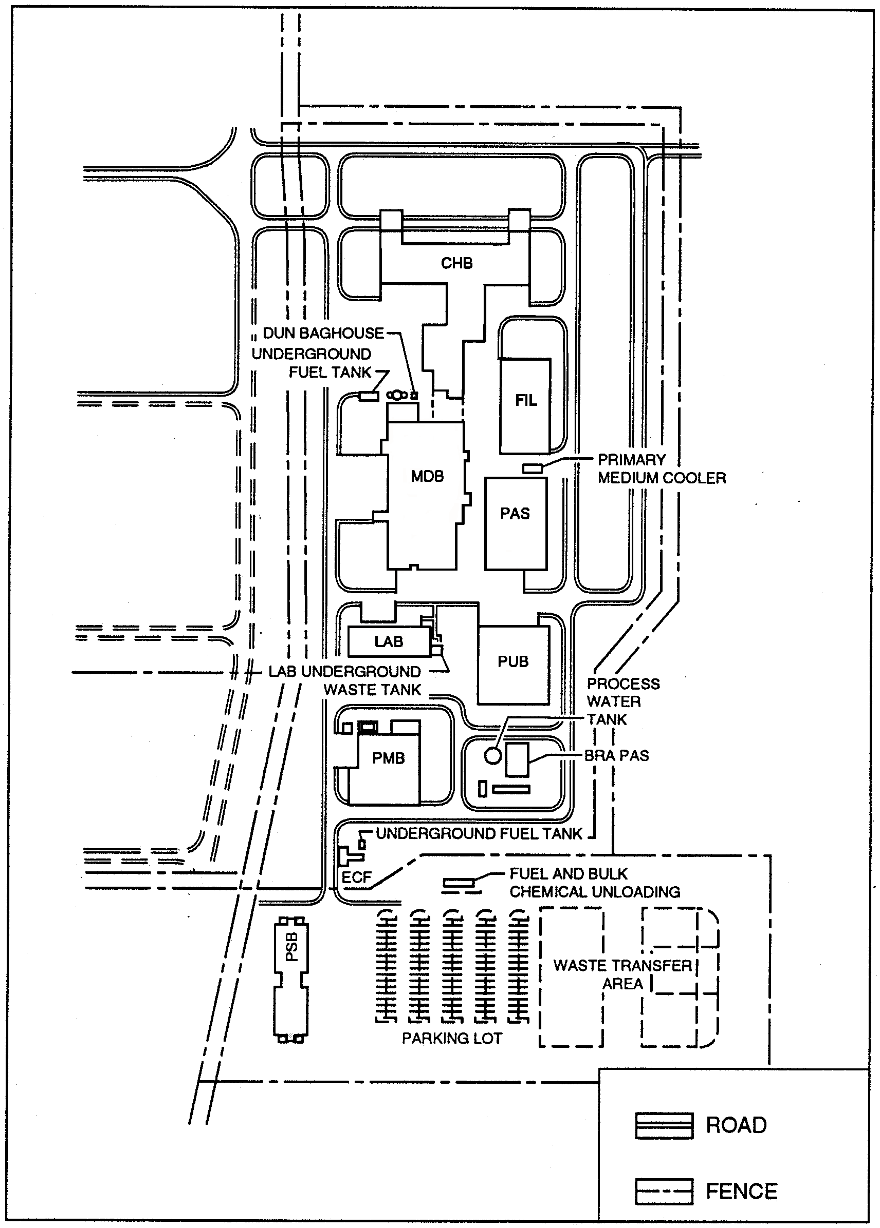


Fig. D.3. Site plan for the baseline destruction facility at the Pueblo Chemical Depot.

The MDB will include a toxic cubicle (TOX) with two tanks for holding agent drained from munitions until the agent is transferred to the LIC. A 1900-L (500-gal) tank will contain liquid agent during routine operations when agent is being transferred to the LIC. A 4920-L (1300-gal) surge tank will provide for containment of extra agent if the LIC is shut down while agent drained from munitions is being transferred to the TOX. The two tanks will have a total capacity of 6820 L (1800 gal) and will be provided with secondary containment of 7800 L (2060 gal). The TOX has sufficient secondary containment to accommodate the contents of both the large and small holding tanks. The MDB will include the control room, storage area, maintenance facilities for equipment contaminated with agent, and facilities for washdown and decontamination.

The main PAS will control emissions of acidic gases and particulates in the flue gases from the incinerators. Each of the three incinerators will be served by an independent system in the PAS. The systems for the DFS, MPF, and LIC will each have a quench tower, a venturi scrubber, a packed bed scrubber tower, and a demister vessel. These systems will share a common stack.

As currently proposed, the PUB will house a residue handling area, boilers, a bulk chemical storage and chemical makeup area, and a forklift battery charging station.

The PMB will house a plant medical facility, a support area for personnel wearing the demilitarization protective ensemble (DPE), change rooms, a lunchroom, a maintenance area, and communications facilities. The medical facility will provide support for possible accident events that could occur during handling, storage, maintenance, surveillance, or demilitarization operations. Qualified medical personnel will remain on-site for each operating shift and will be able to treat victims of industrial and chemical agent accidents. A transport van will shuttle DPE-clad crews between this building and the MDB. The laboratory will be equipped to chemically analyze emissions and wastes for chemical agent content and other pollutants. A tank, which will be managed according to all applicable permits, plans, and procedures, will be used to temporarily store liquid chemical wastes until they are transferred to the LIC.

Two different types of agent monitoring systems will be employed at various places to detect any chemical agent that may escape into the air in and around the proposed facility. The systems will be located inside the MDB, in the exhaust stacks from the PAS, in the filtered exhaust from the MDB ventilation system, and at appropriate locations outside the MDB.

The bulk chemical storage area will consist of equipment and tanks enclosed within the PUB. The perimeter of the bulk chemical storage area will be delimited by a berm to provide secondary containment of the chemicals. In addition, tanks containing acids and bases will be segregated and the hydrochloric acid (HCl) tank will be diked separately to maintain separation of incompatible chemicals in the event of a spill. The bulk chemical storage area will contain tanks of decontamination fluid for neutralization of any agent leaks or spills. One tank will contain an 18% (by weight) solution of sodium hydroxide (NaOH) for acid gas neutralization in the PAS. A 37,800-L (10,000-gal) tank will contain 12% sodium hypochlorite, which is diluted to 5.5% for mustard decontamination and stored in two separate 18,900-L (5,000-gal) decontamination tanks. A 22,700-L (6,000-gal) tank will contain 35% HCl for washing equipment in the PAS.

D.1.2.3 Roads, utilities, and support facilities

Existing PCD roads will be used for transporting construction equipment to the proposed site; these same roads will be used for removal of solid waste (hazardous and nonhazardous) from the facility. A short, new road will connect the existing chemical munitions storage yard with the proposed destruction site; this road will be designed to withstand the weight of the munition-laden vehicles.

Munition transport convoys will proceed from the storage yard, through a new set of gates in the existing security fences, directly to the destruction facility. Thus, all munitions transport will occur inside the high-security area, and the munition transport distance will be minimal. Projected traffic densities resulting from operation of the proposed destruction facility are given in Table D.1.

Natural gas and electrical power will be provided to the site from sources outside the PCD installation. Communications will be provided by connections to the existing on-site service. A packaged sanitary waste treatment system will be constructed adjacent to the proposed destruction facility with effluent directed into evaporation lagoons. The estimated utility demands are presented in Table D.2. Other support facilities will be small in size and will require only minor construction activity. Following are descriptions of the proposed upgrades to existing utilities and facilities at PCD.

Gas service line. Natural gas service would be provided to an interface point, which would allow the future hookup of the site. Approximately 6.5 km (4 miles) of high pressure pipe would be installed. The origination point would be at the Gas Regulator Station that is at 11th Street and 5th Avenue; the pipe would follow the existing roadway easement north to the interface point just south of the site. The gas line would be buried in the shoulder of the access road next to the communications transmission line.

Table D.1. Projected traffic densities (in number of round trips per day) associated with operation of baseline incineration facility at Pueblo Chemical Depot

Vehicle type[a]	Site access road[b,c]	Munitions access road[b,c]	Plant roads[b,c]	Plant roads[b,c]	Chemical Stockpile Disposal Program parking[b,c]
Type of pavement	Asphalt	Asphalt	Asphalt	Concrete	Asphalt
Group 1	60	290	300	150	60
Group 2	20	115	20	20	13
Group 3	40	170	80	800	0
Category V	0	0	0	320	0
Category VI	0	0	0	3	0

[a]Group 1—passenger cars, panel trucks, pickup trucks; Group 2—two-axle trucks, forklifts under 2700 kg (6000 lb); Group 3—three-, four-, five-axle trucks; forklifts 2700 to 4500 kg (6000 to 10,000 lb); Category V—forklifts 4500 to 6800 kg (10,000 to 15,000 lb); Category VI—forklifts 6800 to 9100 kg (15,000 to 20,000 lb).

[b]Maximum single-axle load is 8200 kg (18,000 lb); maximum tandem-axle load is 14,500 kg (32,000 lb).

[c]Round trips per day (estimated facility life is 5 years).

Table D.2. Utility demands for the baseline incineration destruction facility at Pueblo Chemical Depot

Utility	Usage
Process water	
Average	160×10^3 L/day (43×10^3 gal/day)
Potable water	66.2×10^3 L/day (17.5×10^3 gal/day)
Average	
Fire water	
Peak [1.9×10^6 L (500×10^3 gal) storage capacity]	11×10^3 L/min (3×10^3 gal/min)
Sanitary sewer	
Average	78×10^3 L/day (21×10^3 gal/day)
Natural gas	
Average	36×10^3 m^3/day (1.27×10^6 ft^3/day)
Fuel oil[a]	14×10^3 L/day (3.8×10^3 gal/day)
Electricity	
Projected demand	71 MWh/day

1 m^3 = 35.314 ft^3, 1 L= 0.264172 gal, and 1 m^3 = 1000L.
[a]Fuel oil is required for the emergency generators.

Communications service line. Communications service would be provided to an interface point, which would allow the future hookup of the site. Approximately 6.5 km (4 miles) of 24–strand, single–mode, fiber optic cable would be installed. The origination point would be near the PCD housing area; the cable would follow the existing roadway easement north to an interface building just south of the site. The communications line would be buried in the shoulder of the road next to the gas transmission line.

Access road to the site. Approximately 6.5 km (4 miles) of existing PCD road from the entrance gate to just short of the entrance to the site would be widened and improved. It is anticipated that the existing road would be widened to a minimum of 7 m (24 ft) with shoulders and a minimum 8-cm (3-in.) asphalt surface. All the road widening would occur on the west side of the existing roadway.

Electrical substation power service. An electrical substation would be installed to provide power service to the destruction facility. The substation would support a power load of 15 MVA at 13.2 kV with a 3-phase, 3-wire power system. The utility lines would extend approximately 2.4 km (1.5 miles) directly across PCD from the eastern border of the installation to the site.

Personnel support facility. A building would be constructed to house the administrative functions of the destruction facility when in operations and to serve as a management facility during design/construction and systemization. It is anticipated that the building would have approximately 1190 m^2 (12,800 ft^2) of office facilities.

Personnel support facility parking. A parking area would be constructed to support the facility described above. The parking area would accommodate 236 automobiles/small trucks and 5 buses.

Waste transfer area. A paved area would be constructed in close proximity to the parking area described above. This paved area would support the temporary storage and removal of waste when the destruction facility is operating and would serve as an overflow parking area during design/construction and systemization. The 10,220-m^2 (110,000 ft^2) paved area would be curbed and made of concrete.

Warehouse renovations. An existing PCD warehouse would be renovated to support parts storage during destruction facility operations. The renovated warehouse may be used for storage during construction. Approximately 3700 m^2 (40,000 ft^2) of existing warehouse space would receive renovations to the loading dock, the roof, and the electrical, communications, and HVAC systems. If it is not advantageous to renovate an existing warehouse, a new warehouse may be constructed.

Truck gate entrance. The existing truck gate entrance at PCD would be upgraded to allow for control and routing of traffic during construction. Repairs would be performed to fencing, the parking area, and the turn-around road. The control booth would be improved by repairing existing systems including HVAC, water, electrical, sanitary, and security.

Water. Water will be required to support the destruction process, fire, and personnel needs. PCD currently obtains its water from a system of on-site wells, and the present capacity will be sufficient to support the proposed destruction facilities. A new water line will be installed from existing wells to support the proposed destruction operations. It will tie in at a point 9 m (30 ft) outside the exclusion fence. A storage tank will be built to provide reserve capacity for fire protection and operating needs; it will have an earthquake shut-off valve. Water will be treated with chlorine before storage in the tank. All pipelines will be buried a minimum depth of 1.5 m (5 ft) to provide the necessary frost protection.

Diesel fuel and liquefied petroleum gas. Number 2 diesel fuel will be used for the emergency power generators; a liquefied petroleum gas (LPG) and air mixture will serve as emergency backup to the natural gas. The LPG/air mixture will service the incinerators, boilers, and furnaces using the same pipe network as the natural gas. LPG and diesel fuel will be delivered to the facility by tank truck. The diesel fuel tanks will be located outside the fenced plant area and will have a protective roof and containment dikes sized to contain the entire contents of the largest tank. Fuel oil will be unloaded at an unloading station outside the fence and pumped through an underground pipeline to the storage tank. LPG will be unloaded at the on-site storage tank.

Sanitary waste (sewage). Existing PCD evaporative lagoons will be inadequate to support the proposed destruction facility. Sewage from the destruction facility will be processed in a packaged treatment system, and the effluent will be sent to newly constructed lined, evaporative lagoons. The expected quantity of sanitary wastewater averages 78,160 L/day (20,650 gal/day). The wastewater will consist of effluent from facilities such as bathrooms, showers, and laundries. No hazardous chemicals of any type will be discharged into this system.

Storm water. The site drainage system is being designed to direct storm water to a common point outside the fence surrounding the destruction facility. A storm water retention pond is planned.

D.1.3 Process Description

The demilitarization process at PCD will involve five main steps: (1) removal of propellants, (2) transport of munitions from the existing chemical munitions storage yard to the MDB, (3) removal of bursters and fuzes, (4) incineration of munitions, and (5) management of the waste materials that will remain after incineration.

D.1.3.1 Disassembly

All 780,078 chemical munitions stored at PCD contain some form of explosive or energetic component (such as fuzes, bursters, primers, igniters, and propellants). These components would require removal prior to the destruction of the chemical agents.

The disassembly process would involve dismantling of each munition, either manually through the use of robotic equipment. The munitions exiting this process would be energetically inert but would still contain mustard agent in the munition cavity sealed by the burster well. The purpose of disassembly is to ensure that only the inert munition containing the chemical agent moves to the next step of the process, which would involve accessing the agent by drilling or cutting into the munition body prior to destruction of the chemical agent. The scrap energetic components resulting from this process would be either disposed of on-site or shipped to an appropriate, approved off-site destruction facility.

Two types of dismantling have been identified: (1) the removal of propulsive components from those rounds stored in a “complete round” configuration (i.e., the 105-mm cartridges and the 4.2-in. mortar rounds) and (2) the removal of fuzes (if present) and bursters from the warhead portion of each of the stored munitions. Table D.3 describes the activities associated with each type of dismantling for the munitions stored at PCD.

Approximately 16% (125,481 rounds out of 780,078) of the items at PCD are stored in the “complete round” configuration. The remaining 84% of the items are stored without propellants, primers, and igniters. All the munitions at PCD would be subjected to disassembly to remove the remaining explosive components [i.e., fuzes (if present) and bursters].

D.3. Activities associated with reconfiguration of chemical munitions stored at the Pueblo Chemical Depot

	Munition Type			
	155-mm projectiles	105-mm Cartridges and projectiles		4.2-in. mortar rounds
Military designation	M104, M110	M60 Cartridges	M60 Projectiles	M2, M241
Explosive components stored with munitions	Only bursters	Fuze, burster, propellant, primer, igniter	Only bursters	Fuze, burster, propellant, igniter
Maintenance disassembly activities	N/A[a]	Remove propellant charge, primers, brass cartridge cases	N/A[a]	Remove striker nut assembly, ignition cartridge, sheet propellant
Process disassembly activities	Remove bursters	Remove fuzes and bursters	Remove bursters	Remove fuzes and bursters

[a]N/A means “not applicable” because the storage configuration for these munition types contain bursters as the only explosive component.

D.1.3.1.1 Maintenance disassembly

As part of routine maintenance, munitions would be transported from the storage yard to the existing maintenance facility. In the existing maintenance facility, propellant components (assembled cartridge case with propellant, primer and igniter tube) would be separated from the munitions manually. During separation, the munitions would be monitored for agent. Munitions that already have their propellant components removed would directly undergo the enhanced reconfiguration step.

Propellant components would be packaged on-site and disposed in accordance with Depot and regulatory requirements. The munitions (without propellant) would be returned to the igloos for storage. Alternatively, they may be directly transferred to the MDB.

D.1.3.1.2 Process disassembly

Munitions (without propellant) would be moved to the disassembly area within the MDB. The energetic components would be separated from the rest of the munition using mechanical, reverse assembly methods. A machine similar to the projectile and mortar disassembly (PMD) machine used in the baseline design at JACADS and TOCDF would be used to separate the energetic components within an Explosion Containment Room (ECR) in the MDB. The actual number of PMDs used will depend on throughput needs. The PMD design would include a nose closure removal station (NCRS), a miscellaneous parts removal station (MPRS), and a burster removal station (BRS). The burster size reduction machine would likely not be used. The components that would be separated would include the fuze, fuze well cup, and the burster for the 105-mm projectiles (or fuze well cup, burster and inert plug for reconfigured 105-mm projectiles), the lifting plug, fuze well cup, and burster for the 155-mm projectiles, and the combination fuze/burster for the 4.2-in. mortars. For the munitions other than 155-mm projectiles, the nose closure would be sealed with a plug to facilitate further processing. For the 155-mm projectiles, the lifting plug would be retained.

The munition exiting the PMD would be energetically inert and still contain agent in the munition cavity sealed by the burster well. These munitions would be palletized and moved to the igloos for storage. Alternatively, the munitions would be directly transferred to another portion of the MDB for further processing.

D.1.3.1.3 Treatment/disposal of energetic components

Energetic components would be either treated on-site or disposed off-site. If the energetic components can be safely shipped and disposed in accordance with applicable regulations, then these components would be packaged on-site and shipped to a TSDF for off-site disposal. Disposal (including characterization for waste classification purposes) will be conducted in accordance with applicable regulations, and terms of the receiving facility. The energetic components will be packaged and readied for off-site disposal. The energetics may be temporarily stored in igloos prior to off-site disposal.

If the on-site treatment option is pursued, then the energetic components would be treated in a furnace that is similar to the baseline DFS, which is a rotary kiln-type furnace. The proposed furnace to be used for the Pueblo facility would be specifically sized and designed to incinerate energetic components found in the Pueblo stockpile [fuze and burster material (tetrytol and tetryl)]. The design would include safety features and the means to suppress any pressure waves generated in the event of an explosion. The furnace system and its secondary components would be designed as part of the MDB; the design would be modular so that if the off-site disposal option is pursued, then the furnace and associated equipment could be removed from the design without impacting the rest of the destruction process.

If the on-site treatment option is pursued, then the energetic materials would be fed to the proposed rotary kiln using conveyors and feed chutes. Inside the kiln, the components would be conveyed by rotation of the kiln from the charge end to the discharge end. The explosive material would be ignited by the furnace temperature [approximately 820°C (1500°F)] and would burn rapidly. Metal parts and ash would be discharged from the kiln. The decontaminated scrap would be disposed off-site.

An afterburner that operates at approximately 1100°C (2000°F) would be used to further ensure complete combustion of agent and other combustion products in the exhaust gas from the rotary kiln. The exhaust gas would then be treated in a PAS and vented to the atmosphere.

D.1.3.2 Transport and handling

Transport of the munitions from the existing storage yard to the MDB will be a multistep process designed to ensure safety. **The munitions will be transported in a manner that has not yet been determined but that will be as safe as reasonably possible.**

A risk analysis is being performed to evaluate the use of modified ammunition vans (MAVs) for transportation of the PCD inventory in lieu of the on-site containers (ONCs). Preliminary study results indicate that movement with MAVs rather than ONCs will not pose an increased risk to the workers public, or environment. Once the study is completed, the results will be presented to the State of Colorado and Pueblo County to ensure that any concerns they may have would be addressed before a final decision is made on the method of transport. It is expected that munitions will be transported in MAVs as is done at JACADS. At TOCDF munitions are transported in on-site containers (ONCs), but experience with similar mustard-filled munitions at JACADS and Anniston Chemical Activity (ANCA) suggests that ONCs are not needed at PCD. During maintenance disassembly operations for mustard-filled munitions at ANCA, 22,966 105-mm projectiles and 229,518 4.2-inch mortars were transported to and from the reconfiguration facility. The munitions were monitored for agent prior to being loaded onto the transport vehicle and after being unloaded in the reconfiguration facility. No agent was detected before loading. Once the packaging was opened in the reconfiguration facility (within a vapor containment room), 4 105-mm projectiles (less than 0.02%) and 10 4.2-inch mortars (less than 0.005%) were found to be leaking. The leaking agent was contained by the packaging and could not be detected outside the packaging.

Before opening an igloo to remove munitions to be transported, the igloo air will be sampled for the presence of agent. If no agent is detected, the igloo will be opened and loading will begin. Monitoring of igloo air will continue during the work-shift cycle. Storage crews will remain at open igloos to accommodate each shipment. Pallets of munitions will be secured to load trays. Transport will be restricted to daylight hours and permissible weather conditions; therefore, multiple igloos might be simultaneously opened to allow transport of enough munitions and other items to support 24-hr operation of the destruction facility.

If the mustard agent inside munitions is frozen (i.e., in a solid form) because of outside temperatures below 14°C (57°F) for agent HD and 1°C (33°F) for agent HT, the munitions will be thawed in mustard temperature-conditioning systems (MTSs). The MTS is a transportable system with proven capabilities for thawing frozen mustard in ton containers. With little modification the MTS could be configured to thaw mustard-filled mortars and projectiles. Each MTS consists of (1) two thaw boxes with a combined capacity of ten trays of projectiles/mortars (960 small caliber or 720 large caliber) (also included is material handling equipment to overpack leaking munitions); (2) a monitoring house (with a data collection system, DAAMS, and MINICAMS or ACAMS); (3) a dual bed carbon filter system to maintain negative differential pressure on the thaw boxes; a heating plant with dual hot water boilers to supply a hot water solution to the thaw boxes; and (4) a diesel backup generator with an automatic transfer switch.

Each MTS can be easily loaded, agent thawed, and reloaded every 24 hours (loading and unloading would occur only during daylight hours). The MTSs would be located in the storage yard/igloo area (G-block). Munitions would be transferred from the igloos into the MTS boxes; after the required period of time for thawing, the munitions would be transported to the MDB for further processing. The MTS is designed to be compliant with RCRA greater than 90 day hazardous waste storage and Subpart X, Miscellaneous Treatment Unit requirements.

Loaded munition transporters will adhere to a 32-km/hr (20-mph) speed limit. The transport distances from various storage igloos to the proposed destruction facility range from 0.3 to 5.8 km (1000 ft to 3.7 miles). Emergency services will be provided by the operating crew at the igloos with backup from the installation response force.

Once inside the MDB, each load tray will be monitored, unloaded, and its contents moved to the unpacking area. Empty loading trays will be returned to the loading dock for reuse.

In the MDB unpacking area, munitions will be removed from pallets.

D.1.3.3 Pretreatment and incineration

Each munition will be treated by a specific procedure.

- Bursters wells will be removed from the projectiles. The projectiles will be drained. The agent will be transferred to the TOX storage tank and then to the LIC, and the remaining projectile parts will be thermally decontaminated in the MPF. Energetic components from reconfiguration may be sent to the DFS. Ash and particulates from the DFS will be further monitored. If agent is present, the drum of particulates will be cycled within the MPF to ensure that agent is destroyed. If the DFS is not constructed, energetic components would be stored and transported to an appropriately permitted off-site TSDF. The LIC will also incinerate spent decontamination solution periodically used to clean the system.
- Combustible scrap from packaging material for all munitions, spent charcoal filters, and other agent-contaminated wastes will be sent to the MPF.
- Spent charcoal filters may also be incinerated in the MPF.

D.1.3.4 Waste management

Wastes from the proposed facility will include atmospheric emissions, liquid brines, and solid wastes. The primary nonhazardous liquid effluent will be sanitary waste. Most liquids generated by the agent destruction process will be disposed of internally by incineration. Liquid brines will be stored and transported to an appropriately permitted off-site TSDF. Specifics for laboratory waste handling will be developed by the systems contractor in a laboratory hazardous waste management plan. Most likely, hazardous waste will be segregated in the laboratory for off-site disposal at an appropriately permitted TSDF and nonhazardous waste rinse waters will be collected in the laboratory waste tank and will be shipped off-site or disposed of in the LIC.

The PCD destruction facility operations, including waste management, will comply with all applicable federal, state, local, and Army regulations for air and water quality, solid waste, hazardous waste, and noise. The state of Colorado has been delegated authority to implement the federal programs for air and water quality and for most hazardous waste management requirements except those associated with the Hazardous and Solid Waste Amendments of 1984. Colorado adheres to the National Ambient Air Quality Standards (NAAQS) for the prevention of significant deterioration (PSD) of air quality.

Atmospheric emissions. Atmospheric emissions will originate from (1) PASs for the three incinerators, (2) filtered ventilation from process areas, (3) combustion gases from steam boilers and vehicles, and (4) airborne dust from handling of incinerator residue and from vehicle traffic. One common stack will serve the LIC, MPF, and DFS. Handling and disposal of incinerator residue in accordance with requisite provisions of the RCRA permitting process will result in little potential for significant adverse impacts on air quality and, therefore, is not addressed further. Emissions from vehicles and combustion of natural gas and LPG in boilers will be regulated by EPA and the Colorado Department of Public Health and Environment (CDPHE).

The three incinerators with their associated PASs will be required to meet RCRA requirements. The DFS and MPF will be required to destroy agent to a destruction and removal efficiency (DRE) of 99.99% and meet the allowable stack concentrations set by the U.S. Army Surgeon General. The LIC will be operated to destroy agent to a DRE of 99.9999% and meet the agent emission limits established by the U.S. Army Surgeon General. The allowable stack concentrations for all three incinerators have been reviewed and accepted by the U.S. Department of Health and Human Services (DHHS). Emissions of HCl and metals will be regulated in accordance with a RCRA permit. The incinerators will also be required to meet air pollution control requirements for conventional pollutants [e.g., carbon monoxide (CO) and sulfur dioxide (SO_2)] and opacity. Other materials such as dioxins, furans, and small amounts of toxic metals could also be present in incinerator emissions. All stacks will be monitored continuously for agent and periodically for other regulated emissions. Carbon monoxide will be continuously monitored as an indicator of products of incomplete combustion.

Ventilation exhaust air from potentially contaminated areas of the MDB would be filtered extensively before being discharged. In addition, a PAS filtration system has been developed for the incinerator exhaust gases. The PAS filter system consists of six filter units (one each for the LIC and the MPF and two for the DFS, including two shared spares. The DFS will have two filter units in parallel; however, typically, only one unit would be on-line at any one time. Each filter unit consists of a prefilter, a bank of high-efficiency particulate air (HEPA) filters, six 5-cm (2-in.) thick banks of activated charcoal filters in series, and one final bank of HEPA filters. The filter units for the MDB ventilation system have a similar design.

Activated carbon filtration is an accepted method of removing hydrocarbon and similar organic chemicals from air and gas streams. It is commonly used in petrochemical industries, and it is the preferred method for treatment of ventilation airflows in chemical weapons facilities. Fixed-bed activated charcoal filters have been used effectively in this capacity by the Chemical Stockpile Disposal Program (CSDP) for several years. Since complete agent destruction will occur during the incineration processes, these activated charcoal filter units are being incorporated as an additional safety feature to further preclude the potential for a chemical agent release.

The ventilation and incinerator exhaust stacks would be monitored continuously for the presence of mustard agent. Charcoal filter replacement would be rigorously controlled to protect the workers and to prevent release of agent. The spent carbon from the filter units would be incinerated in the DFS or MPF. Current plans are to dispose of the incinerated carbon residue in an off-site permitted hazardous waste landfill.

Liquid wastes. Brine liquids from the PAS are listed hazardous wastes and will be stored on the site until they are transported to an appropriately permitted off-site TSDF. (The state of Colorado has listed all agent-related wastes as hazardous.) Accidental spills of liquid brine would create the potential for environmental damage. Any spilled waste materials will be removed and placed in containers during cleanup in accordance with the PCD Spill Control Plan. Any potentially contaminated soils would be tested and stored in accordance with the PCD Spill Control Plan.

The primary liquid discharge from the facility will be domestic sewage, estimated to average about 78,160 L/day (20,650 gal/day). No process wastewater or hazardous liquid will be discharged into the sanitary system. Sanitary sewage from the destruction facility will be disposed of in lined, evaporative lagoons. Evaporative lagoons would not use secondary water treatment and would not discharge effluent into the surface water or groundwater regimes.

Solid wastes. Solid process wastes will consist of ash and scrap from the incinerators. Hourly waste generation rates are shown in Table D.4. The total process solid waste expected to be generated during the life of the facility is 23,100 metric tons (25,500 tons), a volume of about 15,600 m^3 (550,200 ft^3). These quantities include approximately 8,100 metric tons (8,920 tons) of nonhazardous scrap metal from munition bodies, which will be sold to a scrap dealer or smelter for reuse if possible. However, if a landfill were to be needed due to an inability to sell scrap metal, a permitted off-site landfill will be selected. Currently, there are no plans to dispose of any waste materials from the destruction process in a local landfill. Construction debris and some nonprocess wastes are to be disposed of in a permitted, off-site commercial landfill. Items of salvageable value will be provided to the Defense Reutilization Management Office for recycling. The U.S. Army will be required to comply with all applicable environmental protection regulations governing waste disposal.

Hazardous solid wastes will consist mainly of ash residue from the furnace systems. Hazardous waste will be taken to a permitted waste disposal facility. There are facilities located in California, Illinois, Missouri, and Texas that accept the types of wastes anticipated to be generated.

The analysis of ash from the JACADS incineration operations shows that it is categorized as hazardous waste based on measured parts-per-million (ppm) levels of cadmium, lead, and chromium. JACADS brines have occasionally shown lead concentrations high enough (>5 ppm) to be classified as hazardous waste. Results of waste analyses also indicate that the wastes will

Table D.4. Summary of solid process waste for the proposed destruction facility at the Pueblo Chemical Depot

Source	Type	Generation rate[a] kg/hr	lb/hr
Metal parts furnace	Metal scrap	4,580	10,100
Deactivation furnace	Scrap/ash	630	1,400
Dunnage incinerator	Scrap/ash	80	180
Brine reduction	Brine salts	2,860	6,300
Liquid incinerator	Solids	Negligible	

[a]Rates are maximal and based on peak-limiting process step. Dunnage scrap rates reflect maximum throughput. The total solid process wastes (including protective suits and charcoal residue ash, in addition to munition-specific solid waste) that will be generated during the lifetime of the proposed destruction facility are expected to be about 23,100 metric tons (25,500 tons) [about 15,600 m^3 (550,200 ft^3)]. This quantity does not include munition overpacks, or transport overpacks.

Source: Ralph M. Parsons Co. 1988. *CSDP Waste Management Study*, prepared for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

contain no toxic vapors (such as organics or agent). However, the state of Colorado has listed all agent-related wastes as hazardous. The ash residue to be transported from the destruction facility will be dry and without free liquids. Based on the expected characteristics of these wastes, there will be minimal environmental damage from possible accidental spills, of the ash and/or metal parts. Cleanup would be performed according to the PCD Spill Control Plan.

Transport. The hazardous wastes may be transported off-site by truck. Up to 15 trips could be required on some days, depending on the type of munition being processed. On most days, no more than 11 trips would be required. Waste loads on trucks will be limited to 9 metric tons (10 tons).

D.2. MODIFIED INCINERATION TECHNOLOGY

D.2.1 Facility Description

The modified incineration facility will consist of an MDB, pollution abatement equipment (including filters), and several support buildings. The footprint of the modified incineration facility will be approximately the same as the baseline facility [8 ha (20 acres)].

D.2.1.1 Facility site

The proposed site of the destruction facility based on the modified incineration process is the same as the baseline facility. The extent of excavation and fill work, and design of the drainage system will be approximately the same as the baseline facility.

D.2.1.2 Primary process and process-support buildings

The proposed facility will mainly include the following buildings/areas:

- MDB
- PAS equipment
- Munitions Unloading Area
- Process Support Building (PSB)
- Personnel and Maintenance Building (PMB)
- Process Utilities Building (PUB)

The proposed layout is shown in Fig. D.4 and is based on a conceptual design. This design is likely to evolve as more detailed features are developed.

MDB. The MDB will be the main process building and will be a single-story building that houses all the operations related to agent and munition body incineration and the mechanical equipment that is needed to prepare the munitions for incineration. The baseline design for the MDB ventilation and filtration system that maintains a negative pressure within the building and directs airflow from zones of lower potential for agent contamination to zones of higher potential will be maintained in the modified incineration process. Rooms for process operations will provide agent vapor containment.

To remove explosive materials from the munitions prior to the destruction process in the MDB, the MDB will provide an explosion containment area. The modified incineration process will also differ from the baseline in that no agent storage tanks will be necessary. Agent will not be separated from the munitions; munitions containing agent will be frozen and incinerated full of agent. As in the baseline, the MDB will include the control room, buffer storage area for munitions to be processed, maintenance facilities for equipment, and facilities for equipment and room decontamination.

PAS Equipment. The PAS will control emissions of acidic gases and particulates in the flue gas from the incinerator in the MDB. The PAS equipment will be similar to that used in the baseline design and will include the charcoal filters to scrub the exhaust gas prior to venting to the atmosphere. The charcoal filters will be part of the PAS Filter System (PFS) which will condition the gas prior to venting through a stack.

Munitions Unloading Area. Munitions will be transported to the MDB in MAVs. The vans will be received at an unloading area where munitions will be removed from the vans and transferred into the MDB for processing. This unloading area may be an enclosed structure and will have the capability for temporary storage of munitions and for conveying munitions into the MDB.

PSB, PMB, and PUB. These buildings will have the same function as in the baseline design. Process chemicals to be stored and used will be the same as in the baseline facility.

D.2.2 Roads, Utilities, and Support Facilities

As in the baseline facility, existing PCD roads can be used for transporting construction equipment for the modified incineration facility. Traffic densities on the roads will be on the same order as that estimated for the baseline facility.

The utilities required for the operation of the modified incineration facility will be the same as the baseline facility. These utilities include water (process, fire, potable), fuel (natural gas, diesel fuel, and liquefied petroleum gas), and electricity. The utility corridors, size of the pipelines, and other utility infrastructure will be essentially the same as the baseline.

D.2.3 Process Overview

The modified incineration process consists of a simplified sequence of steps for destruction of the Pueblo munitions. Figure D.5 presents a process overview schematic for the modified incineration process. Figure D.6 presents a block flow diagram of the proposed process.

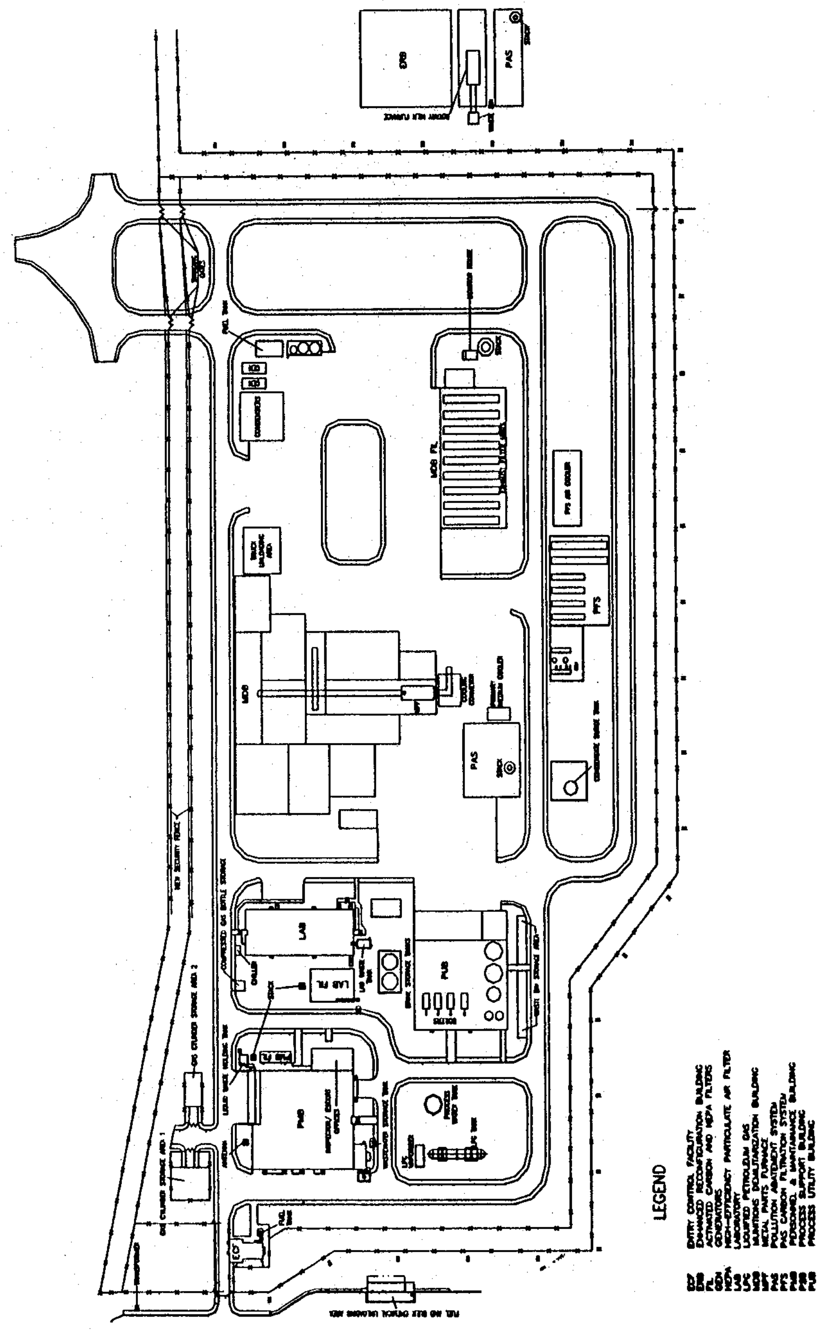


Figure D.4. Conceptual site layout.

After the energetic components are removed in the MDB (see Sect. D.1.3.1), the munitions would either be returned to storage awaiting destruction or frozen to minimize contamination of the facility and would be cut to provide access to the agent. The inert munitions containing frozen agent would be incinerated to destroy the agent and decontaminate the metal parts without separating the agent. The incineration process would result in a flue gas that would be treated in a PAS and PFSs prior to being vented to the atmosphere. Metal parts and ash from the incineration step would be disposed off-site.

The steps involved in the modified incineration process would occur in two buildings: the existing maintenance facility and the MDB. Separation of propellant components would occur in the existing maintenance facility. The energetics separation step would occur in the MDB. The energetics may be shipped off-site or treated on-site. If on-site treatment is pursued, then the energetics treatment would be treated by incineration or ignition in an explosive containment chamber. The freezing, cutting, and incineration steps would occur in the MDB.

Design for containment will be in accordance with Army safety regulations. The MDB would be designed to house all operations related to the processing of munitions containing energetic components. The MDB design would be similar to that of the baseline and would include the cascade ventilation system and filtration of ventilation exhaust air from potentially contaminated areas using activated carbon beds.

D.2.4 Treatment/Disposal of Energetic Components

Energetic components would be either treated on-site or disposed off-site. If the energetic components can be safely shipped and disposed in accordance with applicable regulations, then these components would be packaged on-site and shipped to a commercial TSDF for off-site disposal. Disposal (including characterization for waste classification purposes) will be conducted in accordance with applicable regulations, and terms of the receiving facility. The energetic components will be packaged within the MDB and prepared for off-site disposal. The energetics may be temporarily stored in igloos prior to off-site disposal.

If the on-site treatment option is pursued, then the energetic components would be treated in a furnace that is similar to the baseline DFS which is a rotary kiln-type furnace, or deactivated using another type of explosive containment. The proposed furnace to be used for the Pueblo facility would be specifically sized and designed to incinerate energetic components found in the Pueblo stockpile [fuze and burster material (tetrytol and tetryl)]. The design would include safety features and the means to suppress any pressure waves generated in the event of an explosion. The furnace system and its secondary components would be designed as part of the MDB; the design would be modular so that if the off-site disposal option is pursued, then the furnace and associated equipment could be removed from the design without impacting the rest of the destruction process.

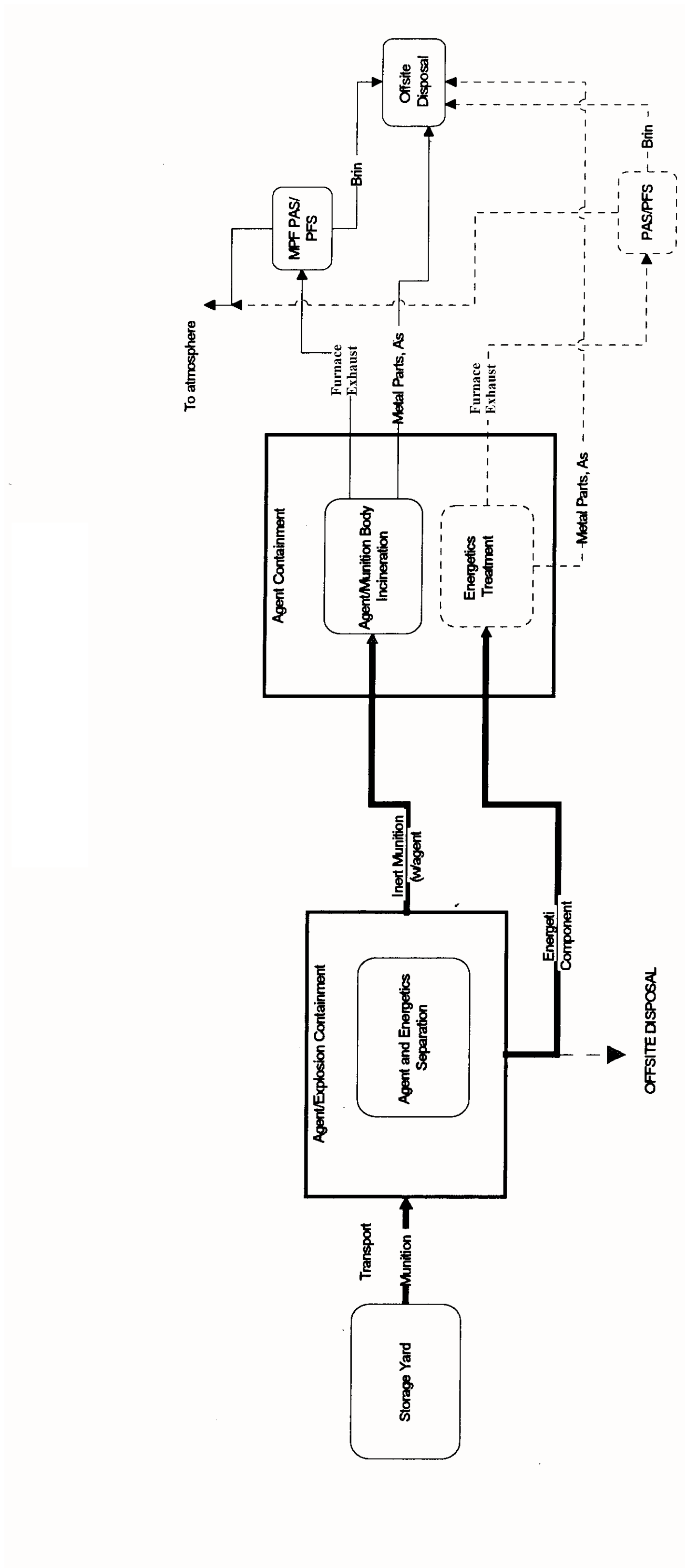


Figure D.5. Process overview.

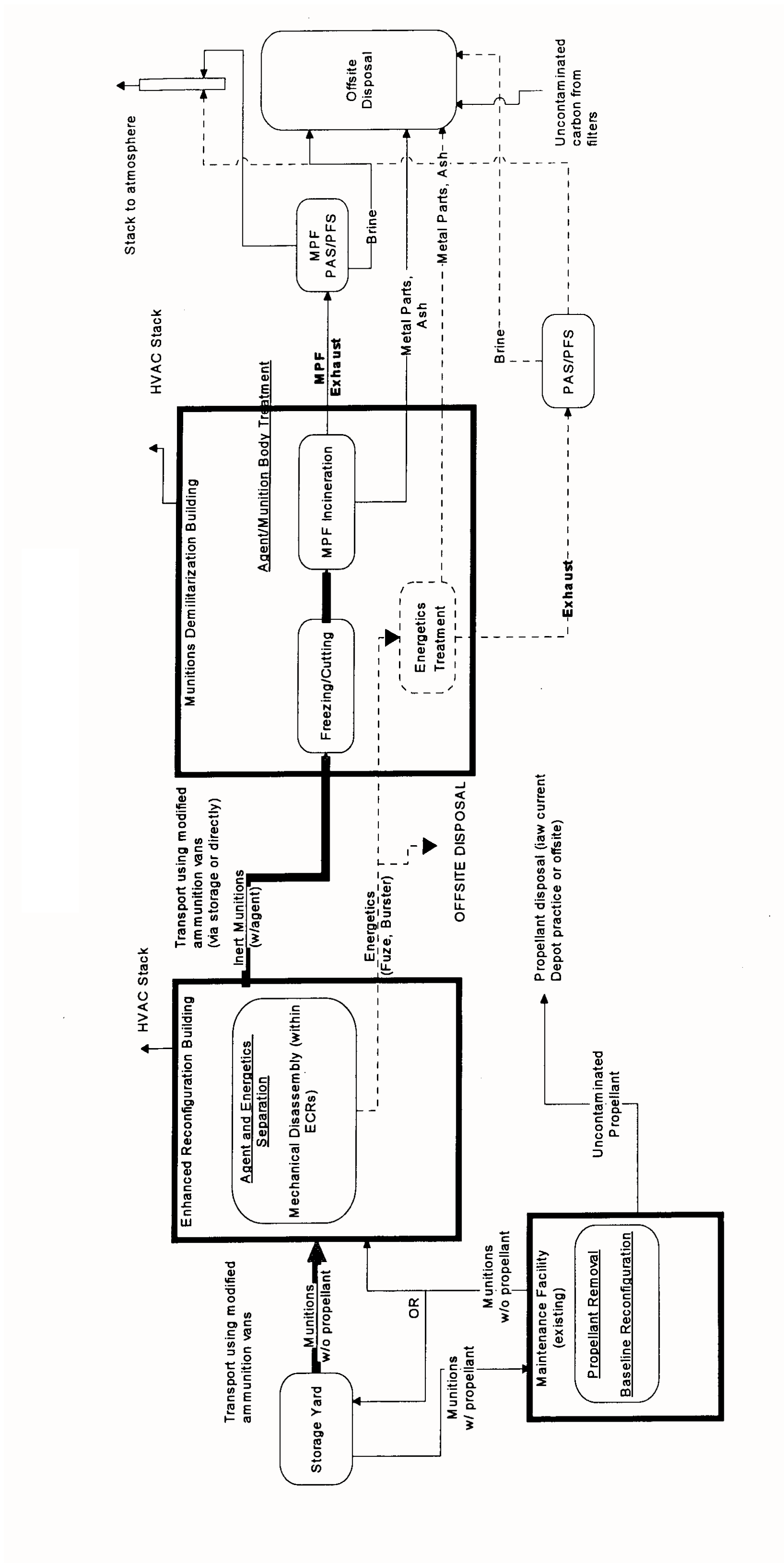


Figure D.6. Block flow diagram.

The energetic materials would be fed to the proposed rotary kiln using conveyors and feed chutes. Inside the kiln, the components would be conveyed by rotation of the kiln from the charge end to the discharge end. The explosive material would be ignited by the furnace temperature [approximately 820°C (1500°F)] and would burn rapidly. Metal parts and ash would be discharged from the kiln. The decontaminated scrap would be disposed off-site.

An afterburner that operates at approximately 1100°C (2000°F) would be used to further ensure complete combustion of agent and other combustion products in the exhaust gas from the rotary kiln. The exhaust gas would then be treated in a PAS followed by a PFS prior to venting to the atmosphere.

D.2.5 Freezing/Cutting

When ready for processing, the inert munitions (containing mustard agent) would be moved from the igloos to the newly constructed MDB.

After removal of energetic components, the inert munitions containing mustard agent will be processed in the MPF. Prior to processing in the MPF, the agent cavity in the munition must be accessed so that the agent can be released and combusted in the incinerator. Previous experience with munitions demilitarization has indicated the potential for foaming of the mustard agent leading to agent contamination of the facility. To overcome this phenomenon and reduce the potential for mustard agent contamination during the agent access step, the modified incineration process includes a step for freezing the mustard agent within the munitions.

After transfer to the freezing/cutting area of the MDB, the munitions would be placed on trays and conveyed into freezers. (Note: For the 155-mm projectiles, the lifting plug would be removed prior to being conveyed into the freezers). The freezers would be maintained at -18°C (0°F) and the munitions would be held for 12 to 24 hr. [Note: HD freezes at 14°C (57°F) and HT freezes at 1°C (33°F)]. Each freezer would be sized to hold approximately 1000 to 2000 munitions. It is expected that there would be three parallel freezer lines.

After the agent is frozen, the munitions would be conveyed from the freezers to a cutting operation. The cutting operation would result in accessing the agent in the munition cavity. The cutting operation may be accomplished by drilling vertically downward so that the nose plug or fuze threads would be removed and the top of the burster well at the location where the well is press fit to the munition body would be removed. Alternate cutting and accessing methods that provide operating advantages may be used.

Following the freezing and cutting operation, the trays containing frozen munitions with the agent cavity accessed would be further processed in the MPF.

D.2.6 Treatment of Agent and Metal Parts

The modified incineration process uses the MPF system for simultaneous incineration of the agent and decontamination of metal parts (munition body). The design of the MPF would be similar to that of the baseline process and may be optimized to improve throughput while retaining the safety features. This application differs slightly from the baseline in which the MPF is primarily used to decontaminate metal parts and incinerate any agent heel (undrained agent). For the modified incineration process, the MPF would be designed to provide adequate heating capacity and residence time for processing the increased amount of agent compared to the baseline process.

The proposed MPF system would consist of a primary furnace and an afterburner. The primary furnace would allow heating of the metal parts to at least 540°C (1000°F) with a minimum residence time of 15 min. The primary furnace is a multiple hearth furnace that provides adequate residence time to ensure that the minimum thermal decontamination requirements, which may vary by munition type, are met.

The primary chamber exhaust gases would flow to the afterburner. The afterburner would ensure the destruction of agent that is volatilized or partially combusted in the primary chamber. This is accomplished by heating the gases to 1100°C (2000°F) for a minimum residence time of 1.0 sec.

Exhaust gases from the afterburner would flow to the MPF PAS for treatment prior to discharge to the atmosphere. The PAS design would be similar to that of the baseline and would include the PFS to filter the exhaust gas prior to discharge to the atmosphere. The PFS would consist of a prefilter, a bank of HEPA filters, banks of activated charcoal filters, a final bank of HEPA filters in series. Brine generated from the PAS will be disposed of off-site and, as a result, a brine reduction area for on-site processing of brine (as installed at JACADS and TOCDF) will not be required.

D.2.7 Transportation and Handling

Munition transfer would be needed for the following movements:

- movement of munitions between the igloos and the existing maintenance facility,
- movement of munitions between the igloos and the MDB.

The munitions will be transported in a manner that has not yet been determined, but that will be as safe as reasonably possible. See the discussion of the on-going transportation risk assessment in Sect. D.1.3.2.

The transport container will be unloaded in a receiving area attached to the MDB. It is expected that the receiving area would be enclosed and would have the capability of safely storing (for temporary purposes only) munitions and conveying munitions into the MDB. In the MDB, the munitions will be moved from the receiving area to the unpacking area where munitions will be removed from the pallets. Movement of munitions within the MDB from beyond the unpacking area will be generally similar to the baseline process.

Procedures for igloo monitoring and loading of munitions would be similar to that of the baseline process. Transportation distance from the igloos to the MDB will be approximately 0.5 to 6.0 km (1500 ft to 3.7 miles).

D.2.8 Utility Estimates

Process-related utility needs for the modified incineration facility will consist of process water, fuel and electric power. Requirements per unit time for other utilities, such as fire water, potable water, sanitary waste handling, and storm water management from construction and operation of the modified incineration facility will be the same as that for the baseline facility. The utility requirements for the modified incineration facility were estimated and are presented in Table D.5. These estimates were prepared based on usage factors obtained from experience at JACADS and adjusted for the conditions specific to the modified incineration facility for Pueblo.

For conservative estimation, utility consumption assumes on-site treatment of energetics. Utility estimates without the on-site energetics treatment furnace are also provided. The rest of the paragraphs discuss the more conservative case (with on-site energetics treatment).

Process water estimates per unit time for the modified incineration facility are expected to be approximately 60% of that of the baseline facility. The reduction in the estimated water requirement is due to the reduced number of furnaces and PAS equipment requiring water for cooling and scrubbing (the modified incineration facility will not have a LIC or a DUN as in the baseline facility). Based on the same reason, the natural gas estimates per unit time for the modified incineration facility are expected to be 50% of that of the baseline facility. Other fuel requirements, diesel fuel for emergency power generators and liquefied petroleum gas for emergency backup to the natural gas for furnaces, will be the same as the baseline facility per unit time. Receipt and handling of fuel oil and LPG will be similar to the baseline facility.

The existing electrical distribution system for PCD will have to be upgraded to meet the electrical usage requirements for the proposed modified incineration facility. The type of upgrade required will be the same as that of the baseline facility. Electrical usage is estimated and provided in Table D.5. The electrical requirement per unit time for the modified incineration facility is expected to be approximately 90% of the requirement for the Pueblo baseline facility.

D.2.9 Input and Output Materials

The major process inputs for the modified incineration process (other than the munitions themselves) are process water, natural gas, air, caustic (NaOH) and bleach (NaOCl). Bleach is used for decontamination of process areas, process equipment, and personnel (in protective equipment). Caustic is used for acid removal from incinerator exhaust gases in the PAS.

The total bleach requirement is estimated to be approximately 0.5 million gal (18% NaOCl). Material requirements for the modified incineration facility are expected to be approximately equal to that of the baseline facility.

The major process outputs from the modified incineration facility will be gaseous emissions (mainly from the furnaces/PAS), liquid effluents (brine), and solids (metal parts and ash from the furnaces). There are no intermediate products that are generated from the process; munitions and energetic materials are directly incinerated to produce exhaust gas, brine, and metal parts/ash. If off-site disposal of energetics is pursued, then energetic components (fuze and burster) will be process outputs (instead of metal parts and ash from the incineration of energetic components).

Table D.5. Utility demands for the modified incineration destruction facility at Pueblo Chemical Depot

Utility	Usage (with energetic furnace)	Usage (without energetics furnace)
Process water[a]		
Average	81.8×10^3 L/day (21.6×10^3 gal/day)	81.8×10^3 L/day (21.6×10^3 gal/day)
Potable water	66.2×10^3 L/day (17.5×10^3 gal/day)	66.2×10^3 L/day (17.5×10^3 gal/day)
Average		
Fire water		
Peak [1.9×10^6 L (500×10^3 gal) storage capacity]	11×10^3 L/min (3×10^3 gal/min)	11×10^3 L/min (3×10^3 gal/min)
Sanitary sewer		
Average	78×10^3 L/day (21×10^3 gal/day)	78×10^3 L/day (21×10^3 gal/day)
Natural gas		
Average	16×10^3 m^3/day (565×10^3 ft^3/day)	10×10^3 m^3/day (345×10^3 ft^3/day)
Fuel oil[b]	14×10^3 L/day (3.8×10^3 gal/day)	14×10^3 L/day (3.8×10^3 gal/day)
Electricity		
Projected demand	71 MWh/day	66 MWh/day

[a]There is a negligible impact on water usage from not having an energetics furnace in the design. Incineration of fuzes/bursters produces insignificant amounts of acid gases, thus requiring relatively small amount of brine for neutralization. Additionally, the water consumption for the energetics furnace PAS is a small fraction of the total plant water usage.

1 m^3 = 35.314 ft^3, 1 L= 0.264172 gal, and 1 m^3 = 1000L.

[b]Fuel oil is required for the emergency generators.

D.2.10 Anticipated Waste Disposition

The major waste streams from the modified incineration facility will be gaseous emissions, brine liquid effluent, and metal parts/ash. These wastes are similar to those generated and disposed in the baseline incineration facility. Liquid brines generated from the PAS will not be processed on-site; instead they will be disposed off-site at a permitted commercial TSDF. Other minor waste streams will be generated from the modified incineration facility that would be similar to those generated by the baseline facility or any other type of demilitarization facility. These waste streams could include maintenance waste, cleanup materials, and laboratory wastes. Depending on the level of agent contamination or if the waste has been generated from agent - related areas, these wastes would be incinerated on-site.

D.2.10.1 Gaseous emissions

Gaseous discharge to the atmosphere will originate from the PASs for the two incinerators [MPF and energetics treatment furnace (similar to DFS)] and from the ventilation system servicing process areas.

The ventilation system exhaust will be filtered using banks of activated carbon similar to the baseline facility. Filtered ventilation air will be vented through a building stack. Stacks will be required for the MDB.

A common stack would be provided for the MPF and the energetics treatment furnace. The incinerators and PASs will be required to meet RCRA and Clean Air Act (CAA) requirements for emissions control. For the Pueblo facility, it is expected that the MPF will be required to pass a surrogate trial burn with an efficiency of 99.9999% and an agent trial burn with an efficiency of 99.99% for chemical agent.[1] In addition, the exhaust gas will be required to not exceed an agent stack concentration of 0.03 mg/m^3. Limits for the energetics treatment furnace are likely to be similar to those for the DFS used in the baseline (99.9999% DRE for surrogates and 99.99% for chemical agent; allowable stack concentration of 0.03 mg/m^3.

The gas characteristics from the MPF for the modified incineration facility are expected to be similar to that obtained during the 4.2-in. mortar trial burn conducted at JACADS with undrained HD.[2] The MPF for the proposed modified incineration facility will be operated under conditions similar to or more restrictive than the JACADS 4.2-in. mortar trial burn. The JACADS 4.2-in. trial burn was conducted with 96 projectiles per tray at a rate of approximately 1.10 tray per hour (residence time of 160 min in the primary furnace of the MPF system). The equivalent agent feed rate averaged 287 kg (632 lb) per hour. Under these conditions, the exhaust gas flow rate was approximately 4350 dry standard cubic feet per minute [dscfm; flow corrected to dry, standard conditions of 101 kPA (760 mm Hg) pressure and 20°C (68°F)]. As in the 4.2-in. trial burn, the agent DRE is expected to exceed 99.9999%

---

[1]The DRE requirement for incinerators will be stipulated in the RCRA permit by the state. Current permits issued stipulate a DRE of 99.99% for the MPF. The requirement may be increased to 99.9999% if the MPF is used as the primary treatment method for agent.

[2]JACADS, Metal Parts Furnace, 4.2-in. Mortar Projectiles Trial Burn Report, August 1999.

and the HD value in the stack gas is expected to be less than 0.00015 mg/m^3 (detection limit), which is over 100 times smaller than the allowable stack concentration of 0.03 mg/m^3.

The gaseous emissions from the modified incineration facility are expected to be similar in nature but lower in quantity in comparison with the baseline facility. Due to the reduction in number of furnaces in the modified incineration facility (no LIC), the quantity of gaseous emissions that will be discharged to the atmosphere will be less than that of the baseline facility (assuming similar durations of operation). The reduction in total gas flow rate between the baseline facility and the modified incineration facility is estimated to be approximately 30%. If the energetics furnace is not used (that is, off-site disposal of energetics is pursued), then the total gas flow rate is expected to be approximately 30% of the gas flow from the baseline facility. Since agent is not expected to be detected in the gaseous emissions from either the PASs of the modified incineration facility or the baseline facility, there will be no difference in the agent characteristics of the gaseous emissions.

The key emission parameters of the gaseous emissions from the JACADS MPF 4.2-in. mortar trial burn are summarized in Table D.6. Since these data are from the 4.2-in. mortar trial burn with undrained HD, they will be very similar to the expected nature of emitted substances from the 4.2-in. campaign from the MPF of the modified incineration facility at Pueblo. In addition, based on anticipated agent feed rates for the different campaigns (4.2-in. mortars, 105-mm projectiles, and 155-mm projectiles), the emission rates for different substances during the 105-mm and 155-mm campaigns are expected to be less than those of the 4.2-in. campaign. The agent feed rates are expected to be approximately 48% of the 4.2-in. campaign for the 105-mm campaign and 94% for the 155-mm campaign.

Table D.6. Summary of data from JACADS 4.2-in. Mortar metal parts furnace trial burn

Emissions parameter	Permit limit	Trial burn results
Allowable stack concentration, mg/m^3	0.03	< 0.00015
HD DRE, percent	99.99	> 99.9999
Particulate matter, mg/dscm (corrected to 7% 02)	180	3.8
HCI, kg/hr	1.8	< 0.003
CO (corrected to 7% 02), PPMV	100	14.1
Oxygen, % dry basis	2.5 to 14.0	9.8

[3]The PFS can reduce the concentrations of organics (and metals to some extent) beyond that reduced by the PAS components upstream of the PFS.

The emission rates from the energetics treatment furnace are expected to be less than those obtained from the JACADS DFS during the 8-in. GB trial burn. During the 8-in. trial burn, bursters, containing Composition B explosive material, that were larger in size were processed. The emissions from processing 4.2-in. bursters (0.14 lb of tetryl per munition), 105-mm bursters (0.51 lb of tetrytol per munition), and 155-mm bursters (0.41 lb of tetrytol per munition) are expected to be less than those from the 8-in. projectiles (7 lb of Composition B per munition). Emissions from the modified incineration facility are expected to be less than 10% of those from the 8-in. trial burn for organics and dioxins/furans, and less than 34% for metals.

For CAA parameters, emission quantities were estimated and compared with the baseline (see Table D.7). These data for modified incineration are rough estimates for comparison with the baseline because actual data are not available.

Table D.7. Emission estimates for modified incineration compared to baseline incineration

Pollutant	PCD (see note[1])	Emissions (TPY) baseline (see note[2])	Modified incineration with energetics	Modified incineration without energetics
CO	43.1	37.0	27.6	18.3
NO	54.8	175.4	134.3	80.6
SO_2	15.7	36.2	35.2	35.2
PM-10	85.8	12.5	6.3	5.1
TSP/PM	89.7	12.5	6.3	5.1
VOC	42.6	1.1	0.7	0.7
Single HAP	8.0	Not available	Not available	Not available
Combined HAPs	20.0	Not available	Not available	Not available

Notes:
1. From page 3 of PUDA construction permit.
2. From PUCDF baseline application, only accounting for the MPF, DFS, and hot water boilers. LIC emissions were included to account for agent being incinerated in the MPF.
3.PM 10: Particulate matter (10 micron)
4. NO: nitrogen oxides
5. $S0_2$: sulfur dioxide
6. PM: particulate matter
7. VOC: volatile organic compound
8. HAP: hazardous air pollutants
9. TPY: tons per year

D.2.10.2 Liquid effluents

The only process liquid effluent from the plant will be brine liquids generated from the PAS equipment. It is expected that four 151,000-L (40,000-gal) storage tanks will be used to store brine prior to off-site shipment. The brine will be shipped off-site to a commercial facility in accordance with applicable regulations for wastewater transportation, treatment, and discharge. Brine is estimated to be generated at an average rate of approximately 76,000 L (20,000 gal) per day. The total quantity of brine to be generated over the life of the facility is estimated to be 549 million L (14.5 million gal). (Note: There is an insignificant change in brine production for the case where energetics are not treated on-site.)

Brine characteristics are expected to be similar to those of the brine generated during the 4.2-in. mortar trial burn at JACADS. No organic constituents (including chemical agent) were detected in the brine above detection limits. Metals data indicates that the brine contains heavy metals at low concentrations, and it is possible that the metal concentrations may exceed regulatory levels for designation as a RCRA hazardous waste. Although not necessary for disposal, the metal concentrations may be reduced on-site prior to shipment, making the brine non-hazardous for metals. However, the state of Colorado has designated all agent-derived wastes as RCRA listed wastes. Additional treatment (at the off-site facility chosen for this purpose) may be needed depending on the requirements for final effluent disposal.

D.2.10.3 Solids

The major solids that would be disposed off-site would be the metal parts/ash that exit the MPF and the energetics treatment furnace. The estimated generation rates are presented in Table D.8. These estimated waste quantities from the modified incineration facility would be expected to be the same as that of the baseline facility because the same number of munitions would be input for both facilities. In addition to metals/ash, activated carbon from filters may be disposed off-site. Activated carbon would be disposed off-site assuming it meets any applicable permit conditions for agent concentration levels and regulatory requirements for off-site disposal. The carbon may need to be disposed at a RCRA permitted facility because of hazardous characteristics for metals. The amount of carbon to be disposed off-site is estimated to be approximately 56 metric tons (62 tons). If the carbon is determined to be contaminated, then it will be treated by on-site incineration.

Table D.8. Estimate of metal parts/ash from the modified incineration facility

Source	Metal parts/ash quantity
Metal parts furnace (MPF)	Average rate: 2,100 lb/hr Total: 18,150 tons
Energetics treatment furnace	Average rate: 100 lb/hr Total: 900 tons

[4]Non-process domestic wastewater will be generated from the modified incineration facility as in the baseline facility.

[5]Entire carbon from the PFS filters and carbon from banks 3 though 6 of the HVAC filters are conservatively estimated for off-site disposal.

If the off-site disposal option for energetics is pursued, then the Army would contract with a TSDF for final disposal. Table D.9 shows the quantities of fuze and bursters that will be disposed. (Note: A small percentage of the fuzes and bursters may be considered contaminated with agent and will be managed by on-site treatment. For conservative estimation, all fuzes and bursters will be assumed to require off-site disposal). Sixteen percent of the munition items are not reconfigured (that is, they are complete rounds with the projectile and propellant components included). The propellant components would be separated and disposed off in accordance with current Depot practice and/or current regulations.

Table D.9. Energetic components in the Pueblo stockpile

Munition type	No. of items	Fuze weight (lb)	Burster type	Burster weight (lb)	Propellant igniter cartridge weight (lb)
4.2-in. HD mortar	76,222	2.15	tetrytol	included with fuze	0.41/0.1
4.2-in. HT mortar	20,384	2.15	tetrytol	included with fuze	0.41/0.1
105-mm HD projectile	28,375	2.15	tetrytol	0.51	8.82
105-mm HD projectile	355,043	N/A	tetrytol	0.51	N/A
155-mm HD projectile	299,554	N/A	tetrytol	0.83	N/A

D.2.11 Depot System/Facilities

The upgrades, modifications, and additions to depot systems/facilities are similar to those described in Sect. D.1.2.3.

D.2.12 Analytical and Monitoring Program

The analytical and monitoring program for the modified incineration facility will use equipment, standards, and procedures similar to those of the baseline facility. The analytical and monitoring program will consist of agent monitoring (vapor phase) for public and worker safety purposes, and analytical characterization of solid and liquid matrices to support treatment and/or off-site disposal. The following paragraphs provide more detail on air monitoring and waste (liquids and solids) characterization.

D.2.12.1 Air monitoring (chemical agent)

The concepts for monitoring the modified incineration facility are the same as those identified for a baseline facility.

Standards for agent exposure. Air exposure limits are the same as those used to regulate baseline facilities. However, since PCD will only process mustard munitions, the immediately dangerous to life and health (IDLH) monitoring standard implemented at a baseline facility is not applicable to PCD operations[3].

[3]Since IDLH levels establish the concentration value at which self-contained breathing apparatus (SCBA) is required, no IDLH value has been identified for HD. When HD concentrations are at or above the time-weighted average (TWA) (0.003 mg/m^3), SCBA is required.

Instrumentation. Instrumentation used to monitor chemical agents will be similar or identical to. those used at baseline facilities. Near-real time monitoring devices will be used to monitor for all monitoring standards, with the exception of the General Population Limit (GPL). Depot Area Air Monitoring Systems (DAAMS) will be used as a confirmation and historical monitor, as currently implemented at the baseline facilities.

Storage monitoring. Storage monitoring will be performed in accordance with baseline facility storage monitoring requirements.

Handling and on-site transport monitoring. Monitoring of munitions during handling and transport will be the same as that performed at baseline facilities. Since ammunition vans will be used to transport munitions on site, they will be monitored prior to unloading munitions. Vapor contents of the ammunition vans interior will be monitored remotely at the completion of each transportation activity. Emergency response for a chemical accident/incident will be handled the same as a baseline facility response.

Destruction plant monitoring. Instrumentation described above will be used to provide a comprehensive monitoring system that meets the same stringent monitoring concepts implemented at a baseline facility. Air monitoring will be provided for worker areas, furnace stack(s), filter vent(s), and process areas. Similar to the monitoring system implemented at baseline facilities, monitoring will provide data to decision makers to ensure operations are being conducted safely and in compliance with all regulatory requirements.

Actual monitoring locations and the number of monitoring locations will differ slightly from those implemented at a baseline facility because of certain design changes (for example, no LIC furnace, no brine reduction area, etc).

Perimeter monitoring. Perimeter monitoring will be performed the same as baseline facility perimeter monitoring.

D.2.12.2 Waste characterization

Waste generated during the operation of the modified incineration facility will be analyzed with the purpose of characterizing the waste for regulatory determination (RCRA hazardous waste) and for ensuring that any permit conditions relating to feed rate limits are met. A detailed waste analysis plan will be developed as part of the RCRA permitting process that specifies the individual waste streams, analytical parameters, and the frequency of analyses. The waste analysis plan will be similar to that of the baseline facility.

Agent screening. Solid and liquid waste streams that have the potential to be contaminated with chemical agent will be screened to determine the level of contamination, if present.

The process solids that will be disposed off-site will consist of metal parts/ash from furnace treatment of munitions. These materials will meet the 5X condition (this condition should destroy chemical agent). However, additional confirmatory agent analysis may be conducted. Ash will be analyzed for agent and RCRA parameters. Other solids that may be generated during the process and that may be contaminated with agent, such as maintenance waste, cleanup waste, etc, will be characterized for agent by monitoring for the purpose of safe handling. These wastes will be incinerated on-site and detailed characterization will not be necessary.

Potentially contaminated liquid waste streams, which include but are not limited to, spent decontamination solution, potentially contaminated laboratory solvents and decontamination solution mixtures, hydraulic fluids, pump oils, and brine effluent will be screened for residual agent contamination. Screening will be performed using an analytical method that has an analytically determined method detection limit at or below the regulated level.

Hazardous constituent analyses. Waste streams that are intended to be shipped off-site will also undergo additional analyses for regulatory characterization. The parameters will consist of RCRA constituents. Brine will be the only process liquid that will be disposed off-site and will be analyzed for corostivity (pH), specific gravity, toxicity characteristic leaching procedure (TCLP) metals, TCLP organics, and total suspended solids.

Standards for waste characterization. The U.S. Army currently implements the waste control limit (WCL) for determining if a matrix is contaminated with residual agent (200 parts per billion for mustard). Wastes will be characterized to levels that will be specified in permits issued for the modified incineration facility. Other hazardous constituents (pH, TCLP, etc.) will be regulated in accordance with RCRA and State of Colorado requirements.

The 200 ppb WCL is based upon an Army drinking water standard. Water containing up to 200 ppb of mustard agent is safe for consumption by soldiers at volumes up to 15 liters per day for a period of 7 days. The 200 ppb WCL may be overly conservative. The Army has developed a methodology for evaluating the health impacts of mustard agent in waste matrices.

Instrumentation. Agent screening instrumentation will be the same **as** instrumentation implemented at a baseline facility. Additional waste characterization parameters will be determined using instrumentation specified by EPA and the state of Colorado.

APPENDIX E

ASSEMBLED CHEMICAL WEAPONS ASSESSMENT PROGRAM TECHNOLOGY DESCRIPTIONS

The following summary descriptions of the three alternatives being considered for destruction of the chemical weapons stockpile stored at Pueblo Chemical Depot are taken directly from:

> Kimmell, T., S. Folga, G. Frey, J. Molberg, P. Kier, B. Templin, and M. Goldberg, 2001. *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement, Volume 5: Assembled Systems for Weapons Destruction at Blue Grass Army Depot,* ANL/EAD/TM-101, Volume 5, Argonne National Laboratory, Argonne, Illinois.

Although the language and figures used in this appendix have been excerpted and copied directly from the ACWA Technology Resource Document, formatting has been altered to facilitate public review of this PMCD FEIS.

Additional detail regarding these technologies may be found in the ACWA Technology Resource Document as well as in documents referenced therein.

E.1 NEUTRALIZATION/SCWO

The neutralization/SCWO technology system consists of neutralization of agents and energetics and secondary treatment of neutralization residuals using SCWO. This technology system, proposed by General Atomics, is applicable to all ACW stored at PCD. It uses a solid-wall SCWO process. The following subsections provide a more detailed discussion of the technologies and processes involved in this system. The technology provider's technology demonstration report (General Atomics 1999) and the ACWA Technology Resource Document (ANL 2001) may be viewed for additional detail.

E.1.1 Process Overview

The neutralization/SCWO process, as applied to projectiles and mortars stored at PCD, is summarized in Figure E.1. As Figure E.1 shows, munitions would be disassembled using a modified baseline reverse assembly process. Once the energetic materials have been removed, agent would be accessed. In the system proposed by General Atomics, this would be accomplished by cryofracturing the munition.[1] However, the agent could be accessed by using

[1]Cryofracture is a system whereby materials are cooled rapidly, usually by immersion in liquid nitrogen. This process embrittles the materials so that they may be easily fractured in a subsequent process.

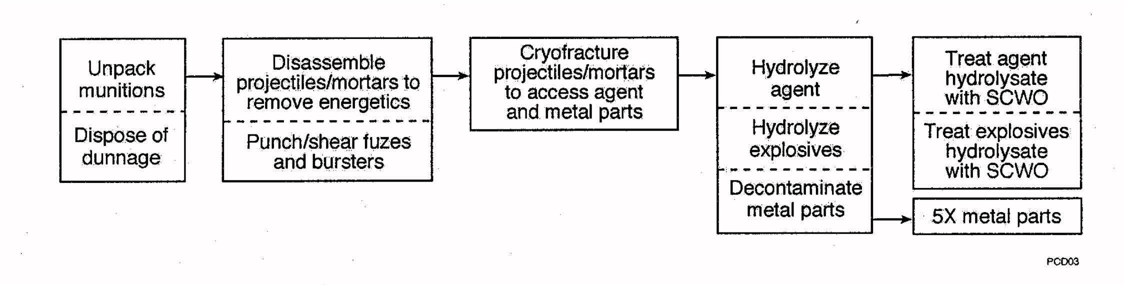


Figure E.1. Overview of the Neutralization/SCWO Process (General Atomics System) for the Treatment of Projectiles and Mortars at PCD (Source: Adapted from NRC 1999; TRD Figure 4.3).

other methods. HD and HT would be neutralized/hydrolyzed using water in systems operated at 194ºF (90ºC) and atmospheric pressure;[2] energetics would be neutralized/hydrolyzed using a sodium hydroxide (NaOH) solution, in systems also operated at 194ºF (90ºC) and atmospheric pressure. Neutralization of HD and HT using water would be followed by a caustic wash using NaOH. Dunnage would be shredded, micronized, hydropulped, and neutralized/hydrolyzed. Resulting hydrolysates would then be treated in separate SCWO units. Dunnage hydrolysate would be added to energetics hydrolysate and would be treated in the same SCWO unit. Thermal treatment would be used to treat metal parts to a 5X condition.[3]

E.1.2 History of Destructive Processes

Neutralization and SCWO are the primary destructive processes employed in this technology. The history of these processes is summarized in the following subsections.

E.1.2.1 Neutralization of Agent and Energetics

Agent neutralization and energetics neutralization by hydrolysis are discussed in detail in a 1999 National Research Council (NRC) report (Appendixes D and E, respectively) (NRC 1999). The literature on neutralization of HD is extensive (NRC 1999). Technically, neutralization is a chemical reaction between an acid and a base to form a salt and water (NRC 1999). In this application, neutralization refers to a hydrolysis reaction in which a target compound is reacted with water, an acid, or a base to break chemical bonds in the target compound (NRC 1999). Chemical demilitarization literature, therefore, often uses neutralization and hydrolysis as interchangeable terms for the same process (NRC 1999). Neutralization using hot water (194ºF, 90ºC), followed by the addition of a caustic (NaOH) is the process that will be pilot tested at APG for destruction of the bulk HD stored there (APG

[2]The unit is not operated under pressure.

[3]To be considered 5X, an item must be either heated to 1000º F (538º C) for a minimum fo 15 minutes or be treated to destroy agent to a level below that determined by the U.S. Surgeon General to represent no adverse health affect. %x material may be released from U.S. Army control in accordance with federal, state, and local regulations.

1997). The NRC references work performed at the U.S. Army Edgewood Research, Development, and Engineering Center (ERDEC)[4] and indicates that neutralization has been shown to reduce HD concentrations in hydrolysate to less than 20 ppb (the analytical detection limit); 99% of the HD is converted to thiodiglycol (NRC 1999, ERDEC 1996). Thiodiglycol is a Schedule 2 compound (see ANL 2001, Appendix B of Volume 1), and the hydrolysate requires further treatment to meet the requirements of the Chemical Weapons Convention (CWC) (NRC 1999). The neutralization reaction with water requires vigorous stirring because HD is relatively insoluble in water (NRC 1999, see also ANL 2001, Appendix C of Volume 1). In addition, a semisolid or gelatinous "heel" of mustard agent can form in stored munitions. The heel, which can amount to up to 10% of the stored agent, can be washed out (NRC 1999). HD hydrolysates contain high levels of thiodiglycol, as explained above, and may also contain a high salt content, various metals, and chlorinated hydrocarbons (NRC 1999). For energetics, this technology involves caustic neutralization using solutions of NaOH. The NRC reports that there is less experience with base neutralization of energetic materials relative to experience with chemical agents (NRC 1999). However, neutralization of energetics has been substituted for open burning/open detonation, a treatment that has historically been applied to these materials (NRC 1999). The open literature contains many references to caustic hydrolysis of energetics, dating back to the mid-1800s (NRC 1999).

The Navy recently published a review of alkaline hydrolysis of energetic materials pertinent to ACW (Newman 1999, as cited in NRC 1999). Base hydrolysis decomposes energetic materials to organic and inorganic salts, organic degradation products, and various gases (NRC 1999). The base used — typically NaOH, potassium hydroxide (KOH), ammonium hydroxide (NH4OH), or sodium carbonate (Na2CO3) — usually attacks all the functional groups of the energetic material (NRC 1999). While previous work with base hydrolysis involved studying reactions under ambient conditions, recent work has been conducted at elevated temperatures and pressures, which increases the solubility of the energetics in solution, increases the reaction rate, and reduces clogging of the reactor vessel (NRC 1999). The reactions, however, are exothermic and must be carefully controlled and monitored to prevent an explosion (NRC 1999).

The NRC indicates that caustic neutralization of energetics is not a mature technology; nevertheless, it concludes that "the current level of understanding is, perhaps, sufficient to indicate that engineering practices can probably restrict the domain of possible reaction products" (NRC 1999). Products from the neutralization reaction may include nitrates, nitrites, ammonia, nitrogen, hydrogen, organic acids, and formaldehyde, as well as various salts (NRC 1999).

E.1.2.2 Supercritical Water Oxidation

The NRC reviews the SCWO process in Appendix F of its 1999 report.

Much of the material in that appendix is based on a review of the SCWO technology for application to VX hydrolysates that the NRC performed in 1998 (NRC 1998). That work was conducted primarily in response to the proposed use of the SCWO technology for treating the VX hydrolysates resulting from neutralization of the U.S. Army's bulk stockpile of VX at

[4]Now known as the Edgewood Chemical Biological Center (ECBC).

NCD, Newport, Indiana. Hydrolysis followed by application of SCWO is nearing the pilot-scale testing phase at NCD (PMCD 1998b, NRC 1999). The U.S. Army prepared an EIS of the hydrolysis/SCWO process proposed for NCD for treatment of bulk VX (PMCD 1998b) and concluded that the proposed facility would meet stringent permitting requirements of the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), and the Clean Air Act (CAA). The U.S. Army further concluded that the site and environs of the facility would be affected by construction and pilot testing of the proposed facility, but that appreciable adverse human health and environmental impacts would not be unexpected, and those that may occur would be well within regulatory limits (PMCD 1998a).

When SCWO is used, the temperature and water pressure are raised to above supercritical conditions (705ºF [374ºC] and 3,204 psia [22 MPa]). Under these conditions, salts precipitate out of solution, and organic compounds are oxidized to carbon dioxide (CO2) and water (H2O) (NRC 1999). Figure E.2 is a simplified process flow diagram for a typical solid-wall SCWO process. SCWO is not widely used within the United States. The NRC reports that SCWO has been used on a pilot scale to treat other types of wastes, but that it is used commercially at only one location within the United States (NRC 1998, as cited in NRC 1999). Although SCWO has been under development for over 20 years, both in the United States and overseas, only recently have problems with the reactor vessel been overcome sufficiently to permit consideration of full-scale operations.

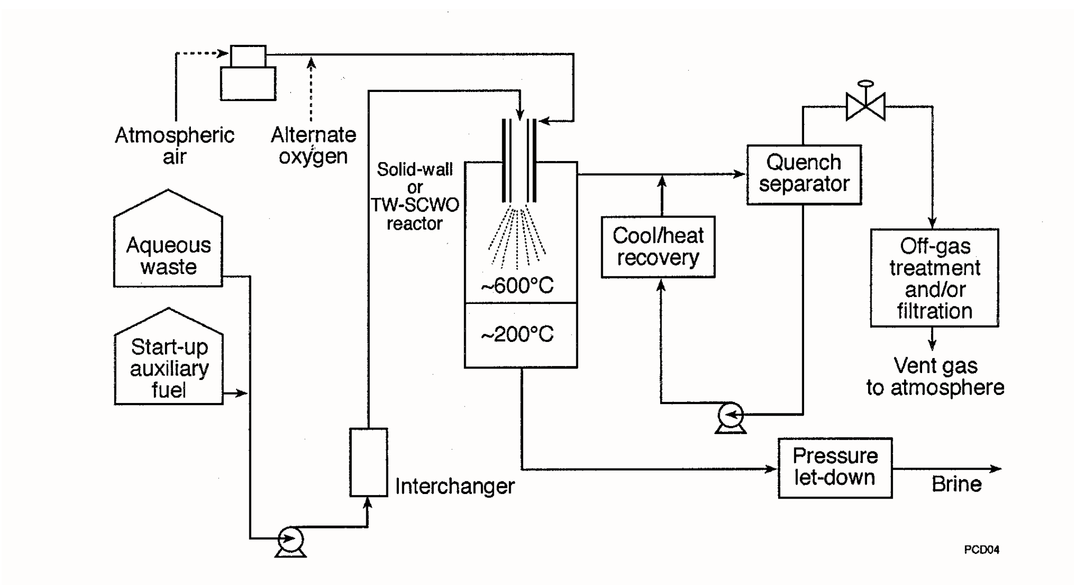


Figure E.2. Typical Flow Diagram for SCWO (*Source:* NRC 1998, as cited in NRC 1999; TRD Figure 4.4).

E.1.3 Process Description

This section presents a process description for neutralization/SCWO as applied to PCD and the ACW stored there, on the basis of demonstration testing results. The equipment used in a pilot-scale facility may vary in nomenclature and design from that described here, on the basis of the system selected and system requirements.

Figure E.3 illustrates the entire process flow for the neutralization/SCWO process. As the figure shows, munitions access would involve use of a modified baseline reverse assembly and cryofracture. Water hydrolysis followed by a caustic wash would be used for mustard agents, while caustic hydrolysis (employing NaOH) would be used to neutralize the energetics. Munition hardware would be treated with caustic in rotary hydrolyzers (i.e., rotating vessels with a helical transport flight[5]): the projectile rotary hydrolyzer (PRH) would be used for agent-contaminated, cryofractured projectiles, and the energetics rotary hydrolyzer (ERH) would be used for all other munition components.[6] Drained agents would be neutralized in continuously stirred tank reactors (CSTRs).[7]

ERH effluent liquids would be treated in similar CSTRs. Dunnage and other organic solid wastes would be shredded, pulverized, and water/caustic pulped (with solids removal) into a slurry hydrolysate. Thermal treatment would be used to decontaminate solids that are not pulped. Solid effluents from the PRH and ERH would pass to modified (inert atmosphere) baseline heated discharge conveyors (HDCs) for thermal decontamination to a 5X condition. Nonshreddable solid wastes (metals, glass, etc.) would receive thermal decontamination to a 5X condition in an induction-heated, inert-atmosphere metal parts furnace (MPF). Munition bodies that have been decontaminated to a 5X condition can be commercially recycled (subject to regulatory agency concurrence). Nonmetal solid waste, if defined as hazardous waste, would be disposed of in a hazardous waste landfill.[8] If defined as nonhazardous wastes, these solid wastes may be disposed of in a nonhazardous waste landfill.

Agent hydrolysate (independent of agent type), energetics hydrolysate from the ERH, and dunnage slurry hydrolysate would undergo secondary treatment in solid-wall SCWO units. The energetics hydrolysate and dunnage hydrolysate would be treated in a separate SCWO processing train. Brine from the SCWO units would be evaporated, the water would be condensed and recycled to the hydrolysis units, and the salts would be sent to a hazardous waste landfill.[9] The salts may require treatment prior to disposal in a landfill to meet RCRA

---

[5]A continuous, flat plate (or “flight”) attached to the inner wall of the vessel, forming a corkscrew or auger-like apparatus from one end to the other. Material is moved along the bottom of the vessel by the helical transport as the vessel rotates.

[6]The terms PRH and ERH are specific to General Atomics. Conceptually, other processes that use a caustic washout design can be substituted for this process.

[7]CSTRs were developed pursuant to the Army’s ATP.

[8]Solids treated to a 5X condition to remove residual agent may be defined as hazardous waste if they exhibit any of the characteristics of hazardous waste, as defined in Title 40, Parts 260.21 – 260.24 of the Code of Federal Regulations (40 CFR 260.21–260.24).

[9]These salts may be defined as hazardous waste if they exhibit any of the characteristics of hazardous waste as defined in 40 CFR 260.21–260.24. Typically, these salts contain heavy metals and exhibit the RCRA toxicity characteristic (40 CFR 261.24). In Colorado, the salts may be regulated as listed hazardous wastes because of their association with chemical agent. If the salts are listed as hazardous wastes, a RCRA delisting petition may be pursued to reclassify the wastes as nonhazardous.

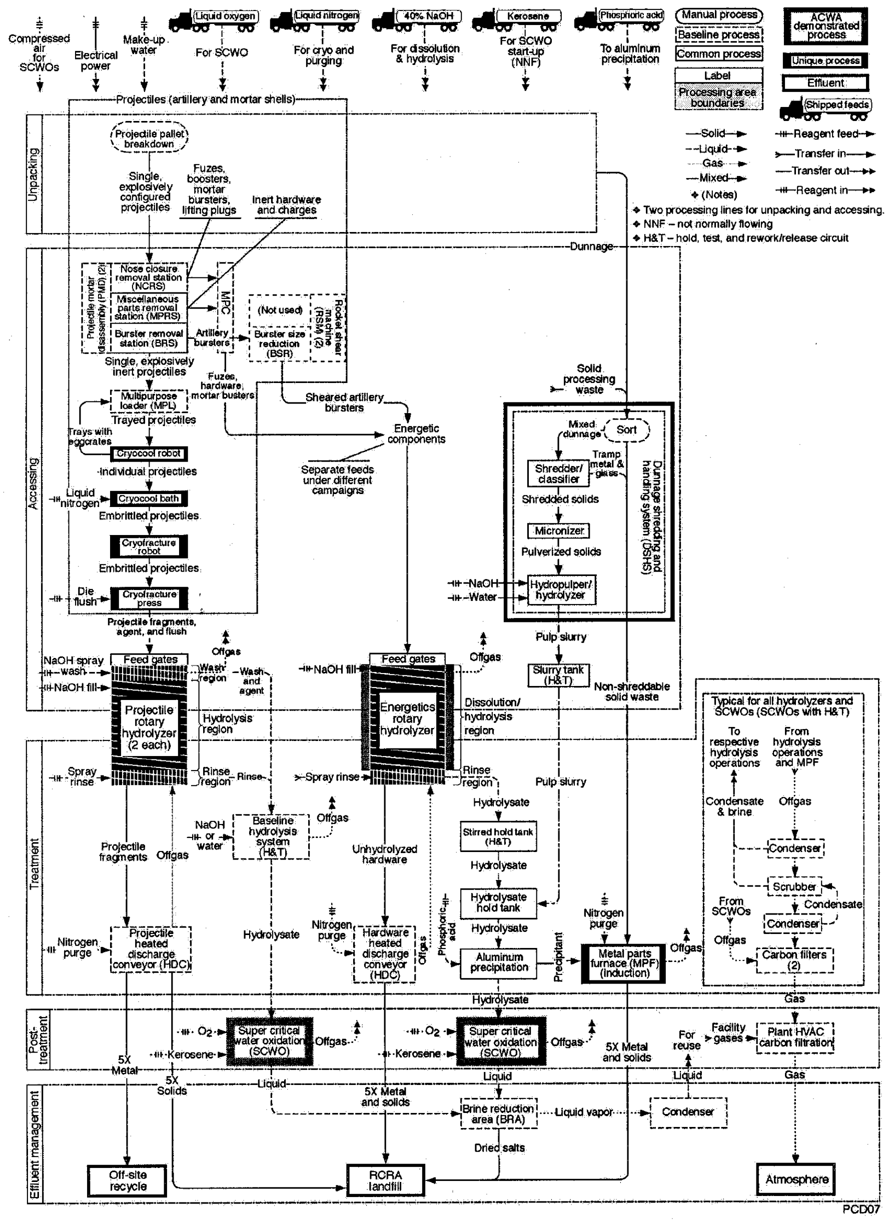


Figure E.3. Flow Diagram of Entire Neutralization/Solid-Wall SCWO Process at PCD (*Source:* Adapted from PMACWA 1999a,b; TRD Figure 4.7)

land disposal requirements. Off-gases from the HDCs would vent to their respective rotary hydrolyzers. Off-gases from the hydrolyzers and the MPF would pass through condensers, scrubbers, and carbon filters before being released to the atmosphere. Liquid from condensers and scrubbers would return to the rotary hydrolyzers for reuse and eventual treatment by SCWO. SCWO off-gas would pass through carbon filters and would be released to the atmosphere.

Short descriptions of each of the unit processes included in the neutralization/SCWO process are provided in the following subsections.

E.1.3.1 Munitions Access – Projectiles and Mortars

The proposed design for munitions access for projectiles and mortars incorporates many of the units and processes used in the baseline reverse assembly processes. Units and processes include reverse assembly machines, material handling conveyors, robotic loaders and handlers, HDCs, elements of the MPF thermal treatment system, auxiliary systems, and facilities and support systems. Some of these units have been slightly modified from the baseline process, but the basic unit and operations have been retained. The major units are summarized below.

The projectile/mortar disassembly (PMD) machine and supporting equipment have been adopted without modification. The PMD is a custom-designed, automated machine that uses a turntable to position munitions at the various workstations arranged around the perimeter of the machine. Munitions are processed in a horizontal position. Fuzes or lifting plugs, nose closures, supplementary charges, bursters, and other energetics are removed. Bursters from projectiles are conveyed to the burster size reduction machine (BSRM). For mortars, the nose closure removal station removes the fuze burster assembly, punches the burster, and unscrews it from the fuze. As determined during demonstration testing, however, the BSRM would not be used to shear the mortar bursters. All removed hardware would be discharged through a chute to the floor of the explosion containment room (ECR).

The BSRM and supporting equipment are part of the baseline process. The BSRM is a modified rocket shear machine used to shear the mortar bursters and includes tooling kits for each burster size.

In the General Atomics system, the projectile/mortar cryofracture process is used to access agent contained in the body of the projectiles and mortars. The process includes LN2 baths and a hydraulic press capable of exerting a pressure of 500 tons (454 t). Two separate cryofracture treatment trains are used. The press has a relatively small bed area and stroke, thereby reducing its size and weight. It fractures one munition body at a time. All of the tooling used in the baseline process has been adapted to the small press, including the same methods for mounting and fragment discharge. A tilt-table is used to discharge fragments into a chute, which delivers the fragments to the projectile rotary hydrolyzer (PRH). Decontamination/flush solution is also supplied to the press tooling and discharge chute.

The cryocool bath is modeled after commercial food-freezing tunnels. A belt conveyor, configured to handle a wide variety of munition types, transports munitions from the loading station into the bath. The cryobath length is sized to provide the residence time needed to ensure sufficient cryocooling of the munition and to support the required throughput rate for the production-scale system. The design of the conveyor and support fixtures minimizes ice and frost buildup. The unit uses baseline bridge robots to transport the munitions from the cryobath to the hydraulic press. Ventilation air is vented through the ducts in the cryocool and press area, where it goes to the PRH.

E.1.3.2 Agent Treatment

Two PRHs would be used for agent treatment. The units would be smaller than the ERH described below but would be similar in design. The PRHs would receive cryofractured projectiles and mortars from the two cryofracture systems. The PRHs would operate in parallel; each would process about half of the projectile/mortar throughput. The PRHs consist of large rotary drums with an internal helical flight as well as lifting flights. The helical flight transports material along the axis of the drum and maintains batch separation. The lifting flights ensure agitation and mixing of the hydrolyzing solution with the agent and metal parts. The drum is steam-traced on the outside surface to maintain an internal operating temperature of about 212ºF (100ºC). At this temperature, agents are readily hydrolyzed. A stationary shell of thermal insulation encloses the drum and minimizes heat loss. The materials move through the hydrolyzer, where water or NaOH solution is continually added at the feed end as agent and metal parts would be discharged by gravity into the drum along with flush solution. The helical flight moves a batch of hydrolyzing solution, agent, and metal parts along the axis of the drum; each batch contains several feeds of agent and metal parts. The drum rotates slowly on drive rollers, and the batch moves such that residence time in the drum is sufficient to ensure complete hydrolysis.

The drum is supported at the discharge end by a spindle through which the coaxial steam supply and return lines pass. Axial loads are also taken by the support trunion of the spindle. High-pressure sprays at the feed end of the drum are used to melt and separate agent and agent heels from the metal parts. Most of the flushed agent and agent heel would flush through a perforated section of the drum at the feed end of the PRH into a tank, where agent hydrolysis continues. Hydrolyzing solution would be added to the metal parts that travel through the drum beyond the perforated section. This hydrolyzing solution would travel through the drum and decontaminate the metal parts; the solution would be discharged through a second perforated section at the discharge end of the drum. The hydrolysate would be transferred to a tank, where hydrolysis would be completed and verified.

Air would be pulled through the PRH to remove volatile organic compounds (VOCs) and other vapors. The air would then discharge to an air treatment system consisting of a scrubber, condenser, and carbon filters, and would eventually be vented through the plant ventilation system.

The neutralization/SCWO system incorporates the ATP neutralization system design being used at APG, with minor modifications to interface with other equipment. The neutralization system includes six CSTRs and associated support systems. The hydrolysis process used for neutralization/SCWO is chemically identical to that used for neutralization/ biotreatment (see Section E.2); however, the physical processes and equipment used are different.

Secondary treatment of the agent hydrolysate to remove Schedule 2 compounds would be accomplished with a solid-wall SCWO unit. The SCWO system for PCD would be sized to process the hydrolyzed mustard agent from the projectiles and mortars. The hydrolysate would first be collected in tanks that are sufficiently large to handle 10 hours of continuous operation.

The SCWO system employs a gas-fired preheater and auxiliary fuel system to heat the reactor to the desired operating temperature (705°F [374ºC]), and the unit is maintained at an operating pressure of 3,400 psia (23 MPa). Hydrolysate flow is initiated, and auxiliary heat is discontinued.

Auxiliary fuel and preheat power are not required under steady-state conditions. The SCWO system for PCD would be similar to that planned for NCD; however, the two SCWO units installed at PCD would be slightly larger. The SCWO system contains components needed to (1) accept and process hydrolysate piped from the hydrolysate holding tanks, (2) release brines to the BRA, and (3) release gaseous effluents to the plant ventilation system.

E.1.3.3 Energetics Treatment

The ERH would be the main element for primary treatment of energetics. The ERH would replace the baseline deactivation furnace system (DFS); however, it has been adapted to the same interfaces with other equipment as the DFS. The ERH would be similar in design and operation to the PRH and would receive energetics and metal parts containing energetics from the ECR.

The ERH consists of a large rotary drum with an internal helical flight as well as lifting flights. The helical flight transports material along the axis of the drum and maintains batch separation. The lifting flights ensure agitation and mixing of the hydrolyzing solution with the energetics and metal parts. The drum is steam-traced on the outside surface to maintain an internal operating temperature of 212 to 230ºF (100 to 110ºC). At this temperature, energetics are melted, and the hydrolysis reaction is enhanced. The materials move through the hydrolyzer, where NaOH solution is continually added at the feed end as energetics and metal parts are discharged by gravity into the drum along with flush solution.

The helical flight moves a batch of hydrolyzing solution, energetics, and metal parts along the axis of the drum; each batch contains several feeds of energetics and metal parts. At the discharge end of the hydrolyzer, a perforated section of the drum permits the hydrolysate to discharge into a CSTR to complete hydrolysis of any remaining small particles of energetics. The hydrolysate is subsequently pumped to continuously stirred holding tanks. The hydrolysate then discharges to the energetics hydrolysate/dunnage hydrolysate SCWO treatment system.

Air would be pulled through the ERH to remove hydrolysis vapors and fumes, including hydrogen produced from the hydrolysis of aluminum burster wells that make up some projectiles. Sufficient air flow would ensure that the hydrogen concentration remains well below the lower explosive limit for hydrogen. The air would then discharge to an air treatment system consisting of a scrubber, condenser, and carbon filters and would eventually be vented through the plant ventilation and carbon filter system.

Secondary treatment of the energetics hydrolysate and added dunnage slurry would be accomplished with a solid-wall SCWO unit identical in design and capacity to the agent hydrolysate SCWO system described above. The SCWO units employed at PCD would be similar in design to the SCWO units planned for pilot testing at NCD. The major difference would be in the slurry feed and the high-pressure pump system.

E.1.3.4 Metal Parts Treatment

The munition bodies would discharge from the PRH to modified baseline HDCs. The metal parts from energetics treatment would continue along the axis of the perforated section of the ERH drum and discharge through a chute to a separate HDC. In both HDCs, metal parts would be heated to a minimum 1,000ºF (538ºC) for a minimum of 15 minutes. The metal parts would be treated to meet a 5X condition, thus destroying residual agent and energetics. Metal from the DSHS would be decontaminated to a 5X condition in the MPF.

E.1.3.5 Dunnage Treatment

Dunnage would be treated during the campaign to the extent possible. Material would be processed by shredding and slurrying. The slurried dunnage would then be treated in the energetics hydrolysate/SCWO system. Although not all dunnage is agent-contaminated, all dunnage would be treated on-site in this manner.

Nonmetallic dunnage materials — wood, paper, plastic, DPE suits, and spent carbon — would be size-reduced in a series of steps and fed to a commercial hydropulper and grinding pump that slurries the material to a particle size of less than 0.04 in. (1 mm). Wood dunnage would be size-reduced in a dedicated low-speed shredder, hammer mill, and micronizer to achieve a fine particle size suitable for slurrying. DPE suits and butyl rubber would be shredded in a dedicated low-speed shredder and then cryocooled and granulated to achieve adequate size reduction. Spent activated carbon would be wet-ground in a dedicated colloid mill. A dilute solution of NaOH would be added to decontaminate the size-reduced solids in the slurry. The resulting slurry is expected to have a particle content of about 10% by weight. This slurry would then be blended with the energetics hydrolysate. At this point, additives would be used to ensure that the solids remain in suspension and that the slurry can be readily pumped and processed in the energetics SCWO system.

E.1.3.6 Effluent Management and Pollution Controls

The effluent management and pollution control systems used in neutralization/SCWO would be similar to systems used in the baseline incineration plant. Elements of the system are described below.

The plant ventilation system is designed with cascading air flow from areas of less contamination potential to areas with more contamination potential. The ventilation system would permit room air-change frequencies consistent with area-level designations[10] for normal as well as anticipated maintenance activities. Plant ventilation flow would be collected in the main plenum and directed to a bank of carbon filters. From here, the air would be filtered and monitored, passed through induction draft fans, and exhausted to the stack and the atmosphere. This system would be nearly identical to the baseline system.

The decontamination fluid supply system and spent decontamination fluid collection system would be the same as those of the baseline system. Decontamination fluid would be supplied to most rooms in the main plant area, and spent decontamination fluid would be

[10]Level A, B, C, D, or E indicates the potential for contamination; Level A is the highest and E is the lowest.

collected in sumps that would be monitored and controlled. That fluid would then be transferred to the spent decontamination system (SDS) treatment area, where it may be mixed with additional decontamination solution to ensure complete destruction of agent. The DPE-supplied air and personnel support system would include maintenance air locks and donning/doffing support equipment and facilities identical to the baseline. The BRA would be identical to that used in the baseline system except that it would be modified to handle brine salts from the SCWO process and water recovery by condensation for reuse in the plant. The BRA includes equipment for effluent drying in heated drums. Dried salts would be disposed of in a hazardous waste landfill.

The plant instrument air supply and steam supply systems would be identical to those employed in the baseline system.

Control rooms would be the same as those used in the baseline system, with changes as needed to accommodate the new systems and equipment.

The process for handling munitions from storage to the unpack area would be similar to that used for the baseline system.

Personnel support, monitoring systems, and analytical laboratories would be identical to those used in the baseline system.

E.1.4 Common Elements – Other Systems

The neutralization/SCWO process has several elements that are identical or nearly identical to other systems. Commonalities with other applicable technology systems include the following:

- The munitions access system used for neutralization/SCWO would employ much of the baseline reverse assembly system, as do the other ACWA systems, and
- Both neutralization/SCWO and neutralization/biotreatment would employ neutralization as a primary treatment for chemical agents and energetics.

Facility structure; ventilation; decontamination fluid supply; personnel support; pollution abatement; water, air, and steam supply systems; control rooms; monitoring systems; and laboratory support would be identical or nearly identical to those of the baseline system.

E.2 NEUTRALIZATION/BIOTREATMENT

The neutralization/biotreatment technology system consists of neutralization of agents and energetics, and secondary treatment of neutralization residuals using biotreatment. This technology system was proposed by Parsons/Honeywell. During demonstration testing, biotreatment of nerve agent residuals (i.e., hydrolysates) was unsuccessful. Because only projectiles and mortars containing mustard agent are stored at PCD, the neutralization/biotreatment technology system is fully applicable to all chemical munitions at PCD. The following subsections provide a more detailed discussion of the technologies and processes involved in this system. The technology provider's technology demonstration report (Parsons/Allied Signal 1999) may be viewed for additional detail.[11]

E.2.1 Process Overview

The neutralization/biotreatment process as applied to projectiles and mortars at PCD is summarized in Figure E.4. A modified baseline reverse assembly process would be used to disassemble munitions. In the proposed Parsons/Honeywell system, modifications would include fluid-abrasive cutting of mortar bursters followed by fluid-mining of burster charges. Other processes could be employed for this purpose, however, including portions of the baseline reverse assembly process. The HD and HT would be neutralized/hydrolyzed using water solutions in units operated at 194ºF (90ºC) and atmospheric pressure; energetics would be neutralized/hydrolyzed using a NaOH solution in units also operated at 194ºF (90ºC) and atmospheric pressure. Neutralization of HD and HT using water would be followed by a caustic wash using NaOH. Agent and energetic hydrolysates would be biotreated together in aerobic reactors called Immobilized Cell Bioreactors (ICBsTM) and would be supplementally treated with hydrogen peroxide/ferrous sulfate ($H_2O_2/FeSO_4$ [Fenton's reagent]). Metal parts

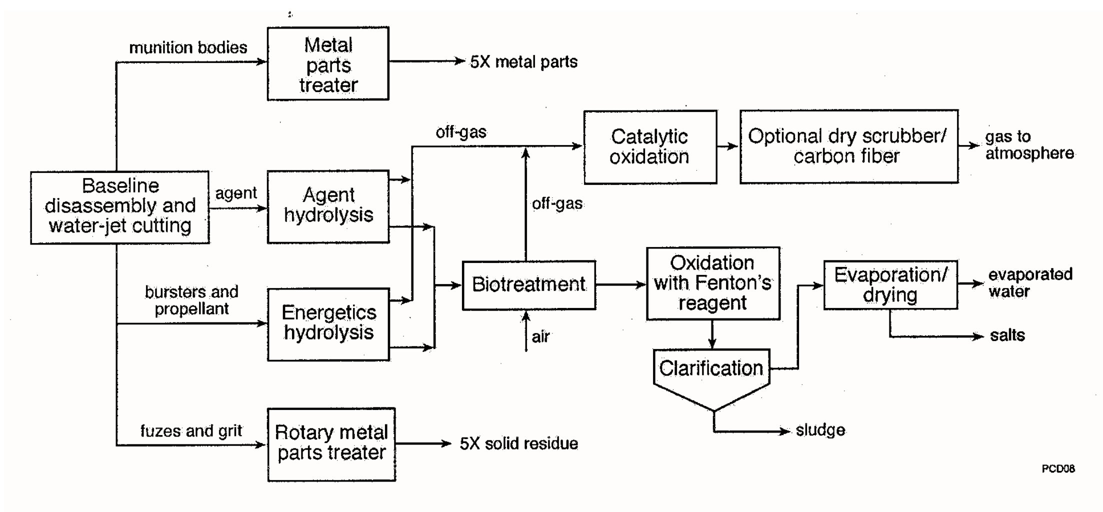


Figure E.4. Overview of the Neutralization/Biotreatment Process (Parsons/Honeywell System) for the Treatment of Projectiles and Mortars at PCD (Source: Adapted from NRC 1999).

[11]Honeywell purchased Allied Signal in early 2000; General Electric purchased Honeywell in 2000. Parsons/Honeywell refers to its ACWA system as the Water Hydrolysis of Explosives and Agent Technology (WHEAT) process.

and dunnage would be decontaminated to a 5X condition in an electrically heated steam furnace. Gaseous discharges would be catalytically converted by a catalytic oxidation (CatOx) system to remove trace organics, oxidizable nitrogen, and chlorine compounds (NRC 1999) before being discharged to the atmosphere. Emissions from the CatOx system would not require high efficiency particulate air (HEPA) or carbon filtration (Parsons/Allied Signal 1999).[12]

E.2.2 History of Destructive Processes

Neutralization and biotreatment are the primary destructive processes employed in this technology. The histories of these processes are summarized below.

E.2.2.1 Neutralization of Agent and Energetics

Agent and energetics neutralization by hydrolysis are reviewed in Section E.1.2. Since the history of neutralization of agent and energetics for neutralization/SCWO does not differ from the history of neutralization of agent and energetics for neutralization/biotreatment, this information is not repeated.

E.2.2.2 Biological Treatment

Different forms of biotreatment have been employed for many years to treat various types of domestic and industrial wastes. Most notable are sewage treatment plants, which are used to reduce the organic, nutrient, and pathogen content of domestic sewage.

Theoretically, microorganisms can degrade almost any organic compound to basic elements (NRC 1999). The use of a biotreatment system is dependent on maintaining a proper environment in which microbes can readily degrade organic contaminants to desired levels. A proper balance of organic food sources and nutrients must be available to the microorganisms (NRC 1999). Other conditions, such as pH, temperature, and oxygen levels, must be carefully maintained. In practice, however, the toxicity of organic and inorganic components in the feed to a biotreatment process can be a limiting factor and requires careful monitoring and control (NRC 1999).

Biotreatment of HD hydrolysates will be pilot tested at APG for the bulk HD stored there. The U.S. Army prepared an EIS for the hydrolysis/biotreatment process proposed for APG (PMCD 1998a). The process involves hydrolysis using a water/caustic solution, followed by biotreatment, and a final polishing step in the facility wastewater treatment plant. The U.S. Army concluded in its EIS that the proposed APG facility would meet stringent permitting requirements of the CWA, RCRA, CAA, and associated State of Maryland regulations. The U.S. Army further concluded that the site and environs of the facility would be impacted by construction and pilot testing of the proposed facility, but that appreciable adverse human health and environmental impacts would be within regulatory limits (PMCD 1998a).

[12]The terms ICB and CatOx are specific to Parsons/Honeywell. Conceptually, other processes using similar techniques could be substituted for these processes.

E.2.3 Detailed Process Description

This section presents a detailed process description for neutralization/biotreatment as applied to PCD and the chemical munitions stored there, on the basis of the results of demonstration testing. Figure E.5 illustrates the entire process flow for neutralization/biotreatment. As the figure shows, neutralization/biotreatment starts with munition pretreatment, which uses baseline reverse assembly, fluid-abrasive cutting, and fluid-mining. Projectiles and mortars would be accessed by baseline reverse assembly. A modified multipurpose demilitarization machine (MMDM) would be used to access and drain the agent cavity. Projectile fuzes and bursters would be removed with the propellant macerator device. The fuzes would be fed to the continuous steam treater (CST), and the bursters would be fluid-mined using water.

Projectiles and mortars, basketed munition hardware, dunnage, and other solid wastes would be thermally decontaminated to a 5X condition in either the metal parts treater (MPT), an inductively heated vessel with a superheated steam reactive environment, or the CST, a rotary version of the MPT with a similar structure to that of the baseline deactivation furnace system (DFS). Steam would be condensed from the MPT or CST off-gas and sent to the condensate recovery system (CRS). Water with a caustic wash would be used to neutralize mustard agent, and NaOH would be used for energetics in CSTRs, similar to the Army's ATP process. Drained agents and CRS effluents would be treated in the agent hydrolyzer, while slurried energetics (from cutting, mining/washing) and spent abrasive wash would be treated in the energetics hydrolyzer.

Agent and energetic hydrolysates would be adjusted for pH, combined, and mixed with reagents and premixed nutrients for aerobic digestion (biotreatment) in the immobilized cell bioreactor (ICB). For all agents, the clarifier side stream would then be sent to water recovery, where it would be evaporated to concentrate the salt content. Sludge from the ICB would be dewatered, packaged, and disposed of as hazardous waste in a RCRA-permitted landfill. This sludge may be defined as hazardous waste if it exhibits any of the characteristics of hazardous waste as defined in 40 CFR 260.21 – 260.24. This sludge may contain heavy metals and may exhibit the RCRA toxicity characteristic (40 CFR 261.24).

In Colorado, the sludge may be regulated as listed hazardous waste because of its association with chemical agent.[13] Liquid from sludge dewatering would be sent to the recovered water storage tank for reuse. All process off-gas would be mixed with air and catalytically converted by the CatOx technology, followed by release to the atmosphere. Oxidized liquid and scrubber brine would be dried — first concentrated by evaporation, with water condensed and reused, followed by crystallizing, with water vapor released to the atmosphere and dry salts sent to a RCRA-permitted facility for further treatment, if necessary, and disposal. Treated munition bodies (5X condition) may be commercially recycled, and treated solid wastes (3X or 5X condition) may be disposed of as either hazardous or nonhazardous waste, depending on regulatory requirements.

Short descriptions of each of the unit processes included in the neutralization/biotreatment process are provided in the following subsections.

[13]If the sludge is listed as hazardous waste, a RCRA delisting petition may be pursued to reclassify the waste as nonhazardous.

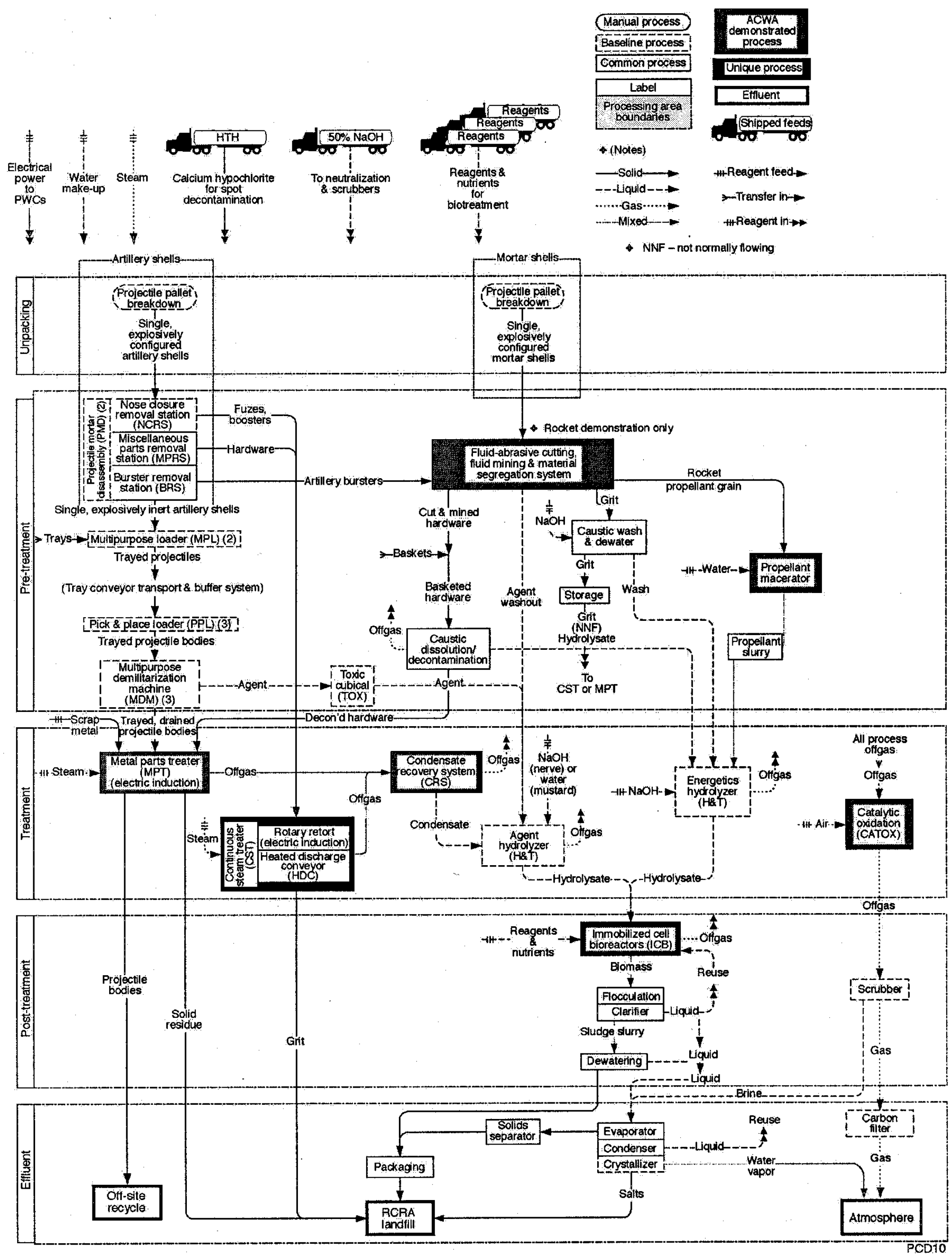


Figure E.5. Flow Diagram of Entire Neutralization/Biotreatment Process at PCD (Adapted from PMACWA 1999b; TRD Figure 4.10).

E.2.3.1 Munitions Access

The proposed design for munitions access incorporates many of the units used in baseline reverse assembly. Units include reverse assembly machines, material handling conveyors, robotic loaders and handlers, HDCs, elements of the MPF thermal treatment system, auxiliary systems, and facilities and support systems. Some of these units have been slightly modified from the baseline process, but the basic unit and operations have been retained. The major units are summarized below. The PMD machine and supporting equipment have been adopted without modification. The PMD is a custom-designed, automated machine that uses a turntable to position munitions at the various workstations that are arranged around the perimeter of the machine. Munitions would be processed in a horizontal position, and fuzes, nose closures, supplementary charges, bursters, and other energetics would be removed.

Bursters would be conveyed to the multistation fluid-accessing machine, where energetics would be removed through the fuze end of the item by a high-pressure multijet fluid nozzle using water. The multistation fluid-accessing machine replaces the BSRM. Empty burster casings would be sheared in the burster shear station. The munitions would then be transported to the MMDM, where the burster well would be pulled from the item, thereby exposing the agent. The agent would then be drained using aspiration. The burster well would be crimped, placed back into the munition body, and conveyed to the MPT. The fuzes and burster casings would be sent to the rotary version of the MPT, the CST. Agent would be conveyed to holding tanks in the toxic cubicle (TOX), where it would be stored prior to introduction to the agent hydrolyzer. Energetics washout would be conveyed to the energetics hydrolyzer.

E.2.3.2 Agent Treatment

An agent hydrolyzer would be used for agent treatment. Hydrolysis would be conducted in a CSTR, which is similar to the unit used for energetics treatment. The feed would be added to the CSTR, which contains water at the required reaction temperature. Batches would be adjusted as necessary and then released to storage prior to biotreatment. The neutralization technology would incorporate the ATP neutralization system design that will be used at APG, with minor modifications to interface with other equipment. It is chemically identical to that used in neutralization/SCWO (see Section E.1.3.2).

Secondary treatment of the agent hydrolysate to remove Schedule 2 compounds would be accomplished using biotreatment. Both the agent hydrolysate and energetics hydrolysate would be treated in the same bioreactor. Concentrated hydrolysates from these operations would be stored until they are fed to the bioreactors. Recovered water would be added, as well as nutrients needed by the microbes used to biotreat the hydrolysates. The bioreactors would process the hydrolysates and pass a clean effluent on to the water recovery operation.

The ICBs used for biotreatment are proprietary reactors. However, other biotreatment processes may be substituted for the proposed biotreatment system. Agent and energetic hydrolysates would be combined in the ICB feed tank with a premixed nutrient solution. This feed would be continuously metered to the bioreactor. Outside air would be forced through the reactor beds. Bioreactor effluent would be taken to a flocculation unit, where sludge would be precipitated out and prepared for removal. The reagent used (Fenton's reagent) would also remove color and odor from the bioreactor effluent. A clarifier would be used to remove the sludge as a slurry that would be pumped to a water recovery unit. Clarifier overflow would be pumped to a recycled water storage tank for subsequent reuse in the system. Biosolids and biosalts would be solidified and disposed of as hazardous waste in a hazardous waste landfill. Noncondensable gases from this system would be passed through the CatOx unit prior to release to the atmosphere.

E.2.3.3 Energetics Treatment

The main element for primary treatment of energetics would be the energetics hydrolyzer. The energetics hydrolyzer replaces the baseline DFS but has been adapted to the same interfaces with other equipment as the DFS. The energetics hydrolyzer is similar in design and operation to the agent hydrolyzer and receives washed-out energetics from the multistation fluid-accessing machine.

The feed would be added to the hydrolyzer, which contains NaOH solution at the required reaction temperature. After the required reaction time, a sample of the hydrolysate would be analyzed for agent and energetics. Batches would be additionally treated as necessary and then released to storage prior to biotreatment. Biotreatment would follow the same process as discussed above for agent hydrolysates.

E.2.3.4 Metal Parts Treatment

The metal parts from munitions access would be processed by the MPT, which would either be a tube-type or rotary device that is induction heated. In the MPT, projectile and mortar bodies would be decontaminated to a 5X condition in a superheated steam atmosphere. Induction coils would be used to ramp up the temperature through a prescribed cycle. Volatile liquids would be vaporized and removed by the steam, which would be condensed downstream in the CRS.

The liquid condensate from the CRS would be taken to the SDS, where it would be diluted with the low-concentration alkaline solution of the spent decontamination fluid and subsequently added as makeup water to the agent hydrolyzer. Noncondensable gases would be processed through catalytic converters (the CatOx system).

Energetic hardware — specifically fuzes, nose closure plugs, projectile burster casings, and fuze booster cups — would be processed through a similar device, the CST. As indicated previously, this unit would be a modified version of the MPT and can operate in continuous feed mode.

E.2.3.5 Dunnage Treatment

Dunnage would be treated during the campaign to the extent possible. It would be steamtreated in the MPT. Although not all dunnage is agent-contaminated, all dunnage would be treated on-site in this manner.

E.2.3.6 Effluent Management and Pollution Controls

The effluent management and pollution control systems used in neutralization/ biotreatment would be similar to systems used in the baseline incineration plant. Included are scrubbers, condensers, and carbon filters, which are used to remove residual organics from contaminated areas before discharge to the atmosphere. The neutralization/biotreatment system would also include a CatOx system, which would be used to treat organic constituents within the air stream. Two different CatOx units would be employed. One would be used for the bioreactors, and the other would be used for all other systems. Both CatOx units would operate in an identical manner.

The CatOx units that would be used for the bioreactors are not intended to treat agent. They would be provided solely to treat organic compounds that would emanate from the ICB feed or that would be generated during the biodegradation process. Incoming air streams would be heated electrically to reduce moisture and to condition the gas to the CatOx operating temperature. The catalytic matrix within the device is designed to reduce organic materials to basic elements. The bioreactor CatOx units would discharge directly to the atmosphere (no scrubbers or carbon filtration) since it is unlikely that they would receive any agent (Parsons/Allied Signal 1999). The CatOx unit that would be used for the other systems in the neutralization/biotreatment process may vent to the scrubber/carbon filter system as a precaution.

All other systems would be identical to the baseline system, including the personnel support system, the plant instrument air supply and steam supply systems, control rooms, the process for handling munitions from storage to the facility, personnel support, monitoring systems, and analytical laboratories.

E.2.4 Common Elements – Other Systems

The neutralization/biotreatment process has several elements that are identical or nearly identical to other systems. Commonalities with other applicable technology systems include the following:

- The munitions access system used for neutralization/biotreatment would employ much of the baseline reverse assembly system, as do the other ACWA systems; and
- Both neutralization/biotreatment and neutralization/SCWO systems would employ neutralization of chemical agents and energetics.

Facility structure, ventilation; decontamination fluid supply; personnel support; pollution abatement; water, air, and steam supply systems; control rooms; monitoring systems; and laboratory support would be identical or nearly identical to those of the baseline system.

E.3 SUPPLEMENTAL INFORMATION FOR ASSEMBLED SYSTEMS AT PUEBLO CHEMICAL DEPOT

This section provides supplemental information for pilot testing ACWA technology systems at PCD. Included are facility descriptions, system inputs and resource requirements, routine emissions and wastes, and activities and schedules. This section addresses construction and operation of the facility. As the pilot-scale facility design matures, deviations are expected. However, it is anticipated that the final design would result in estimates similar to those provided in the tables in this section.

E.3.1 NEUTRALIZATION/SCWO

This description of the neutralization/SCWO facility is based on preliminary design information provided in General Atomics (1999). As indicated in that report, many of the estimates provided for facility design refer comparatively to the U.S. Army baseline incineration process, which indicates, in general, that estimates are comparable to those for the baseline incineration process (General Atomics 1999). Thus, one of the primary sources of information for this section is the EIS for disposal of chemical agents and munitions stored at Pine Bluff Arsenal, Arkansas (PMCD 1997). That is the most recent EIS that the U.S. Army has prepared for baseline incineration of chemical munitions. Figure E.6 provides an input/output material balance for the major streams for neutralization/SCWO of ACW at PCD containing mustard agent.

In addition to the above, mass balance estimates, air emission estimates, and solid waste estimates for application of the neutralization/SCWO technology at PCD have been developed (Mitretek 2001b). Air emissions and solid waste estimates for neutralization/SCWO, as discussed below, are based on Mitretek inputs, along with appropriate assumptions on filtration systems, plant operations, and schedule. Much of the data presented for this technology system

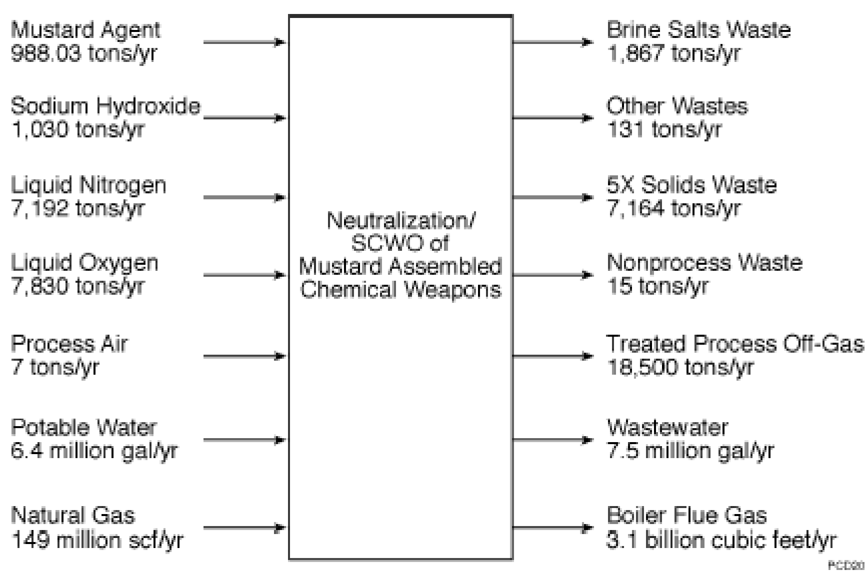


Fig. E.6. Input/Output material balance for Neutralization/ SCWO of ACW containing mustard agent at PCD.

comprise estimates (e.g., emissions, resources consumed) associated with processing ACW with a specified agent; these estimates are given on an annual basis (e.g., tons/yr). In some cases, the estimates have been converted from other units (e.g., lb/d) by accounting for the number of days of operation required for processing a specific type of ACW. The values in many of the following figures and tables are based on the number of days required to process ACW containing mustard agent. It was assumed that there are 276 operating days in a year. Daily (or other) quantities may be obtained by adjusting for the number of days of operation.

E.3.1.1 General Facility Description

The proposed neutralization/SCWO facility is designed to fit approximately into the same space and general configuration as the baseline incineration process. Munitions access and disassembly, base hydrolysis, and SCWO operations have been substituted for baseline incineration operations. The physical plant consists of a two-story building constructed of noncombustible materials, with a concrete structural frame and a low-slope concrete roof.

The site layout for the neutralization/SCWO facility is shown in Figures E.7 through E.9. Figure E.7 shows the general facility layout, Figure E.8 shows the layout of the first floor, and Figure E.9 shows the layout of the second floor.

E.3.1.2 Operations Inputs and Resource Requirements

At full-scale operation, destruction of the mustard agent inventory at PCD is projected to require 731 days for processing (Mitretek 2001b). It is estimated that operations would require approximately 32 months at full-scale operation (see Table E.1). This duration is based on a 12-hours-per-shift, 6-days-per-week operation, 46 weeks per year, with three 2-week munition changeout periods (General Atomics 1999).[14]

Annual utility consumption for facility operation, including electricity, fuel, and potable water usage, is presented in Table E.2.

E.3.1.3 Operations Emissions and Waste Estimates

Wastes from the neutralization/SCWO process would include air emissions and solid wastes. According to the technology provider, the only liquid effluent expected from the destruction facility would be sanitary waste, which would be managed on-site. All liquids generated by the process and all liquid laboratory wastes would be reused in the process or disposed of internally by neutralization/SCWO. Destruction facility operations, including waste management, would comply with U.S. Army, federal, state, and local requirements.

Any wastes that are identified as hazardous would be stored and disposed of in compliance with RCRA requirements. Summary descriptions of the types of emissions and solid wastes are provided in the following paragraphs.

[14] The full-scale scenario has been selected as the bounding case for this analysis.

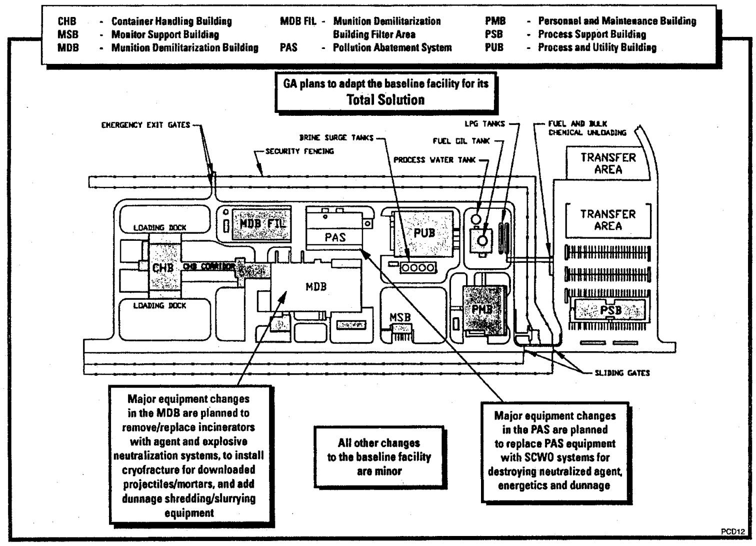


Figure E.7. Neutralization/SCWO Facility Layout at PCD (*Source:* General Atomics 1999; TRD Figure 4.13).

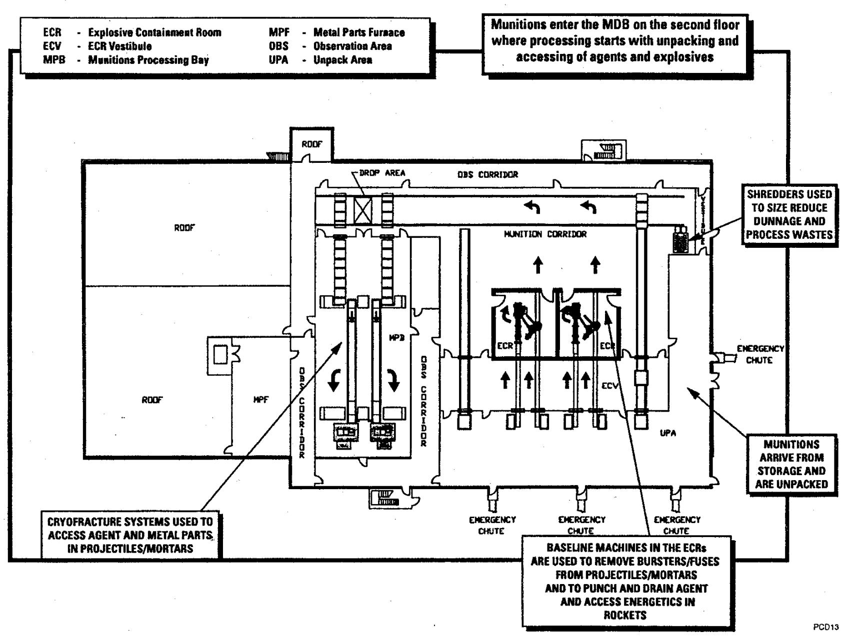


Figure E.8. Layout of first floor of the Munitions Demilitarization Building for the Neutralization/SCWO Facility at PCD (Source: General Atomics 1999; TRD Figure 4.14)

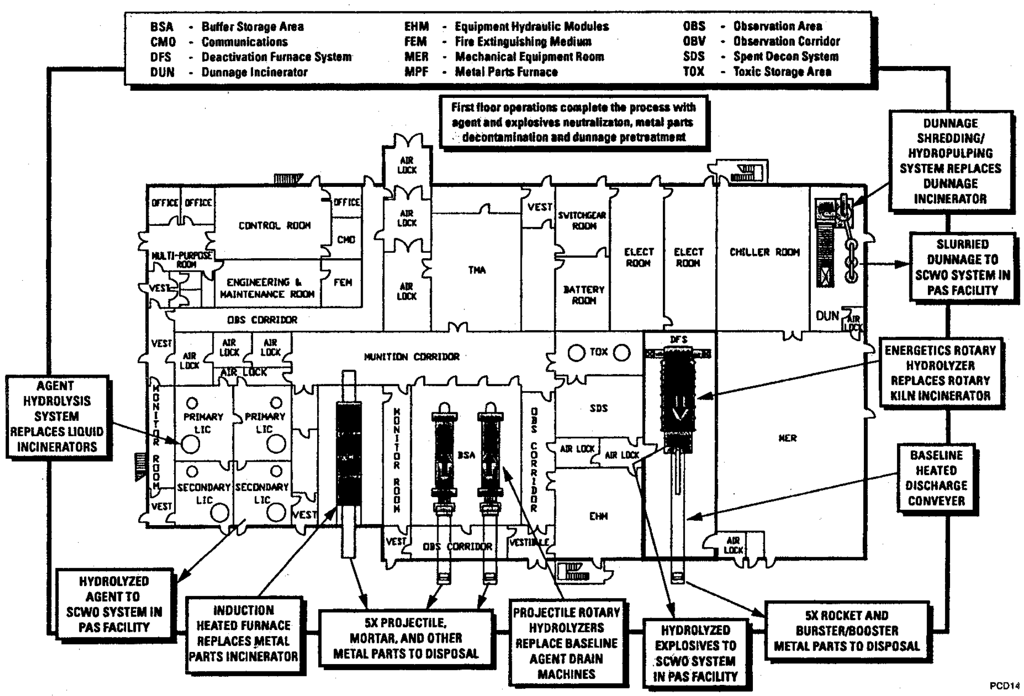


Figure E.9. Layout of the second floor of the Munitions Demilitarization Building for the Neutralization/SCWO Facility at PCD (*Source:* General Atomics 1999; TRD Figure 4.15).

Table E.1. Estimated total wastes generated during construction of a Neutralization/SCWO Facility at PCD

Waste category	Quantity
Hazardous solids	90 yd^3
Hazardous liquids	35,000 gal
Nonhazardous solids	
Concrete[a]	200 yd^3
Steel[b]	36 tons
Other[c]	1,600 yd^3
Nonhazardous liquids	
Sanitary[d]	5.1E+06 gal
Other	2.3E+06 gal

[a]Amount of concrete (nonhazardous solid) waste estimated by assuming that 0.65% of concrete usage is spoilage.

[b]Amount of steel waste stream was estimated as 0.5% of the steel requirement on the basis of LLNL et al. (1997).

[c]Amount of other waste stream was estimated as eight times the concrete stream on the basis of LLNL et al. (1997).

[d]Amount of sanitary waste was estimated on the basis of the total construction workforce.

Atmospheric Emissions. The major process gaseous residuals expected from the neutralization/SCWO operation include the following:

- Nitrogen gas from the cryofracture operation;
- Ventilation gases from the ERHs, PRHs, and MPF;
- Ventilation gases from the agent hydrolysis system; and
- Gases from the agent hydrolysate and energetics/dunnage hydrolysate SCWO systems.

These gases would be vented through scrubbers to the facility ventilation system, where they would pass through carbon filters prior to release to the atmosphere. Handling and disposal of process residue in accordance with the provisions of RCRA are expected to result in little potential for significant adverse impacts on air quality. Emissions from vehicles and combustion of natural gas and liquefied petroleum gas (LPG) are regulated by the U.S. Environmental Protection Agency (EPA) and the State of Colorado and are expected to result in little potential for significant adverse impacts on air quality. Dust emissions would also be controlled during operations.

Table E.2. Estimated utilities consumed during destruction of ACW at the Neutralization/SCWO Facility at PCD

Utility	Average daily consumption	Peak-day consumption	Annual consumption
Process water[a]	4,800 gal/d	130 gal/min	1,300,000 gal/yr
Potable water[b]	17,500 gal/d	800 gal/min	6,400,000 gal/yr[c]
Fire water[b]	NA[d]	3,000 gal/min	NA
Sanitary sewer[b]	20,650 gal/d	395 gal/min	7,540,000 gal/yr[c]
Natural gas[a]	540,000 scf/d	43,000 sch/h	149,000,000 scf/yr[e]
Fuel oil	962 gal/d	406 gal/h	48,000 gal/yr[f]
Electricity	163 MWh	18 MW	59.6 GWh[c,g]

[a]Estimated on the basis of the ratio of the mustard agent processing rate at PCD to that of the NCD destruction facility.
[b]Assumed to be similar to incineration because the number of operations and maintenance personnel and land area are unchanged from incineration (PMCD 1988).
[c]Based on 365 days of operations per year.
[d]NA = not applicable.
[e]Based on 276 days of operation a year.
[f]Estimated on the basis of 600 hours of emergency diesel generator operation per year.
[g]Based on an annual power rating of 80%.
Source: COE (1987); TRD Table 4.14; and private communication (e-mail from Penny Robitaille, PMCD, to Time Ensminger, ORNL, dated Dec. 19, 2001).

The neutralization/SCWO process would be required to meet RCRA requirements and to operate under permit. The process would be required to destroy agent to a DRE of 99.9999% and to meet agent emission limits as established by the U.S. Army Surgeon General (ASG). Other emissions, including metals and HCl, would be regulated in accordance with the RCRA permit. The operation would also be required to meet air pollution control requirements for conventional pollutants, such as CO, SO2, and opacity.

All ventilation air would be processed through carbon filtration units before release to the atmosphere. Facility effluent release points would include gaseous releases to the environment. Table E.3 summarizes the emission rates of criteria pollutants during normal SCWO operations. Daily emissions can be estimated from the hourly rates, assuming 12 operating hours per day. Small amounts of organic and metallic compounds would be emitted from the combustion of natural gas during normal boiler operations and from the combustion of fuel oil during normal boiler operations.

Table E.3. Estimated Hourly and Annual Emission Rates of Criteria Pollutants during Normal Neutralization /SCWO Operations at PCD.

	Process stream boiler[a]		Diesel generator eshaust[b,c]		SCWO stack	
Criteria pollutant	lb/h	tons/yr	lb/h	tons/yr	lb/h	tons/yr
CO	3.8	6.26	10.4	3.12	0	0
NO_x	6.3	10.43	48.4	14.50	0	0
SO_x	0.03	0.04	3.2	0.95	0	0
PM_{10}	0.34	0.57	3.4	1.02	0	0
HC	0.25	0.41	4.0	1.18	0	0
N_2O[d]	0.0	0.00	0.0	0	15.0	15.5
N_2[d]	0.0	0.00	0.0	0	2.4	2.2

[a]Estimated on the basis of the utility requirements listed in Table 4.14.
[b]Based on 600 hours of operations per year.
[c]Operation similar to neutralization/biotreatment assumed.
[d]Based on Table 4.5-1 and 4.5-2 in General Atomics (1999).
Source: TRD Table 4.18.

The neutralization/SCWO facility at the PCD would be equipped with building ventilation systems that would discharge, to the atmosphere, indoor air from the Munitions Demilitarization Building (MDB) process area, the Laboratory Building, and the Personnel and Maintenance Building through the filter farm stack. Of the three ventilation systems, only the indoor air from the MDB process area would be potentially exposed to chemical agents during operations.

To estimate the maximum potential emissions of chemical agents, only the MDB process area was considered to be a significant potential source. The filter systems would be designed to remove chemical agents from the ventilation air streams to levels below the allowable stack concentrations that have been recommended by the U.S. Department of Health and Human Services, Centers for Disease Control (53 *Federal Register* 8504–8507, March 15, 1988). Table E.4 gives the potential chemical agent emission rates on the basis of the assumption that the chemical agent concentrations in the air discharged from the filter farm stack would be at 20% of the recommended allowable stack concentrations (i.e., the level of quantification of the ventilation exhaust chemical agent monitors).

Table E.4. Estimated maximum hourly and annual agent emission rates from the filter farm stack for Neutralization/SCWO at PCD

Chemical agent	Emission factor (mg/m^3)[a]	Stack exit gas flow (acfm)[b]	Hours of operation per year[c]	Stack emission rate lb/h	Stack emission rate tons/yr[d]
HD, HT	0.006	96,000	3,312	2.2E-03	3.6E-03

[a]Based on the monitor level of quantification, which is 20% of the allowable stack concentration recommended for each chemical agent in 53 CFR 8504-8507.

[b]Filter farm stack exit based on building ventilation for the MBD.

[c]Hours of operations based on the assumption that each pilot plant operates at the design throughputs specified in CBDCOM (1997).

[d]Estimate based on the number of hours of operation per year.
Source: TRD Table 4.21.

Liquid Wastes. As indicated previously, brine liquids from the SCWO units would be sent to the BRA, where they would be dried to form brine salts. Other liquids, such as spent decontamination solutions and laboratory wastes, would be fed to the SCWO units.

Domestic sewage is the only liquid effluent expected to be generated at the facility. Small amounts of hazardous liquids could be generated from chemical makeup and reagents for support activities; the quantities may be minor compared to those for domestic sewage (sanitary waste). Sanitary wastes would be managed on-site.

Solid Wastes. The major process solid residuals expected from the neutralization/SCWO operation include the following:

- Brine salts from treatment of the SCWO effluent,
- Decontaminated (5X condition) scrap metal from the HDCs and the inductively heated MPF, and
- Decontaminated (5X condition) Al(OH)3 salts removed from the energetics hydrolysates and thermally treated in the inductively heated MPF.

The effluent from the SCWO unit would be sent to an evaporator that produces a filter cake with about 70% solids. The water content is bound as water of hydration; free-standing liquid is not expected (NCD 1998b). The filter cake would be transported to an approved off-site hazardous waste treatment, storage, and disposal facility for additional treatment and/or ultimate disposal.

Nonhazardous scrap metal (5X condition) from the munition bodies would be sold to a scrap dealer or smelter for reuse, if approved by the regulatory authority. However, if necessary, these metals could be disposed of off-site in a nonhazardous waste landfill, or in a RCRA-permitted hazardous waste landfill. Brine salts would be disposed of offsite in a permitted hazardous waste landfill. Currently, the U.S. Army does not intend to dispose of any waste materials from the destruction process on-site.

Nonprocess waste streams would include decon solution, DPE suits, spent carbon, waste oils, trash, debris, and spent hydraulic fluid, which are assumed to be potentially agent contaminated and would be processed in the dunnage/waste processing system. After this processing, the only streams with a significant solid residue would be the decontamination Nonhazardous scrap metal (5X condition) from the munition bodies would be sold to a scrap dealer or smelter for reuse, if approved by the regulatory authority. However, if necessary, these metals could be disposed of off-site in a nonhazardous waste landfill, or in a RCRA-permitted hazardous waste landfill. Brine salts would be disposed of offsite in a permitted hazardous waste landfill. Currently, the U.S. Army does not intend to dispose of any waste materials from the destruction process on-site.

E.3.2 NEUTRALIZATION/BIOTREATMENT

This description of the neutralization/biotreatment facility is based on the preliminary design information provided in Parsons/Allied Signal (1999). As indicated in that report, many of the estimates provided for facility design refer comparatively to the U.S. Army baseline incineration process, which indicates, in general, that the estimates are comparable to those for the baseline incineration process (Parsons/Allied Signal 1999). Thus, one of the primary sources of information for this section is the EIS for disposal of chemical agents and munitions stored at Pine Bluff Arsenal, Arkansas (PMCD 1997). That is the most recent EIS that the Army has completed for baseline incineration of chemical munitions.

In addition, mass balance estimates, air emission estimates, and solid waste estimates have been developed for application of the neutralization/biotreatment technology at PCD (Mitretek 2001a). Air emissions and solid waste estimates for neutralization/biotreatment, as discussed below, are based on Mitretek inputs (Mitretek 2001a), along with appropriate assumptions on filtration systems and plant operations and schedule. Figure E.10 provides an input/material balance for the major streams for neutralization/biotreatment of ACW containing mustard agent.

Many of the figures and tables referred to in the facility description for this technology system contain estimates (e.g., emissions, resources consumed) associated with processing ACW with a specified agent; these estimates are given on an annual basis (e.g., tons/yr). In some cases, the estimates have been converted from other units (e.g., lb/d) by accounting for the number of days of operation required for processing a specific type of ACW. The values in many of the following figures and tables are based on the number of days required to process ACW containing mustard agent. It was assumed that there are 276 operating days in a year. Daily (or other) quantities may be obtained by adjusting for the number of days of operation.

E.3.2.1 General Facility Description

The proposed neutralization/biotreatment facility is designed to fit into approximately the same space and general configuration as the baseline incineration process.

Munitions access and disassembly, base hydrolysis, and biotreatment operations have been substituted for baseline incineration operations. The physical plant consists of a two-story building constructed of noncombustible materials, with a concrete structural frame and a low-slope concrete roof. The site layout for the neutralization/biotreatment facility at PCD is shown in Figures E.11 through E.13. Figure E.11 shows the layout of the first floor, Figure E.12

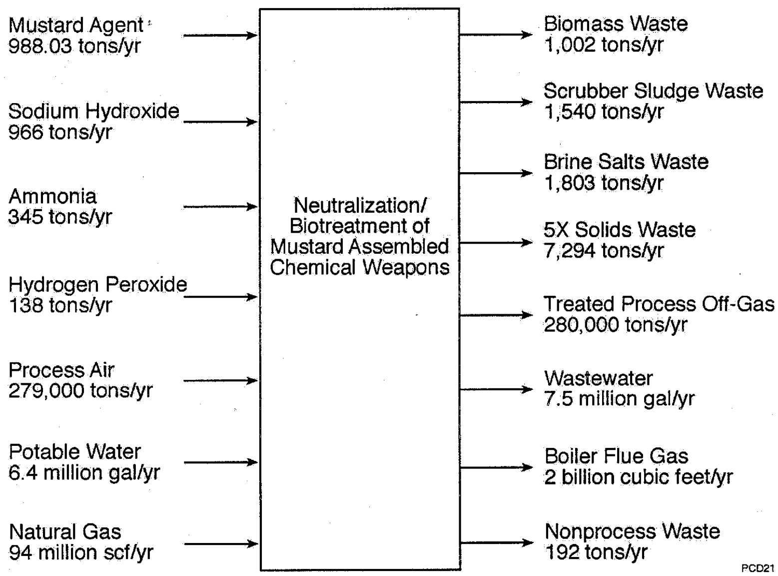


Figure E.10. Input/output material balance for Neutralization/Biotreatment of ACW containing mustard agent at PCD.

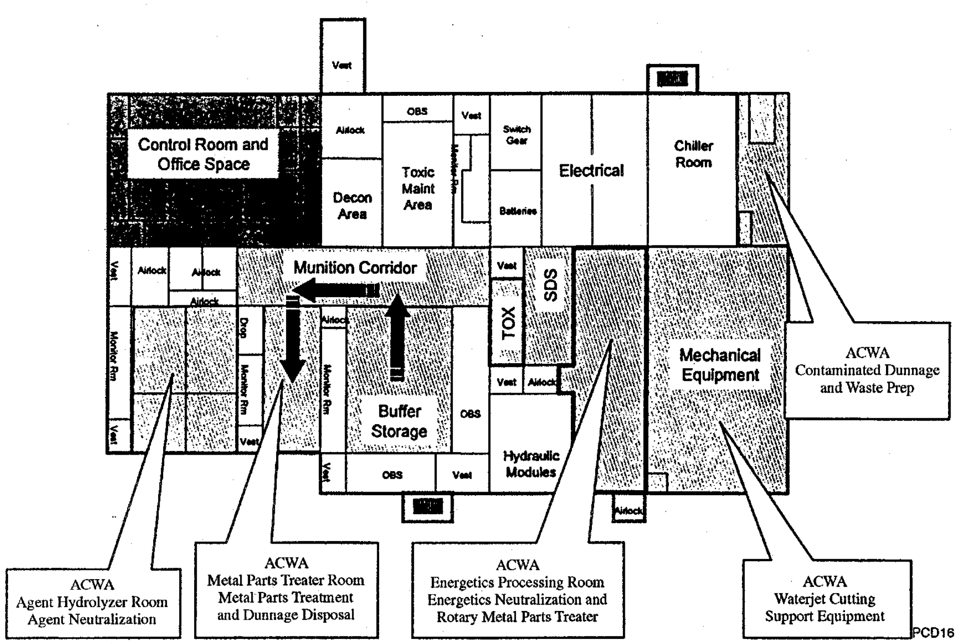


Figure E.11. Layout of first floor of Neutralization/Biotreatment Facility at PCD (*Source:* Parsons/Allied Signal 1999).

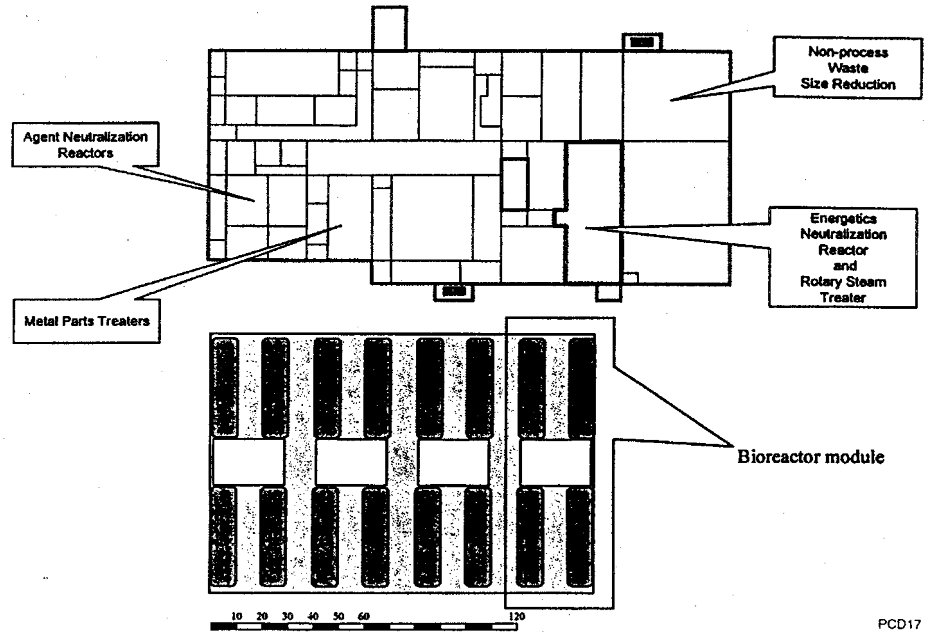


Figure E.12. Layout of second floor of Neutralization/Biotreatment Facility at PCD (*Source:* Parsons/Allied Signal 1999).

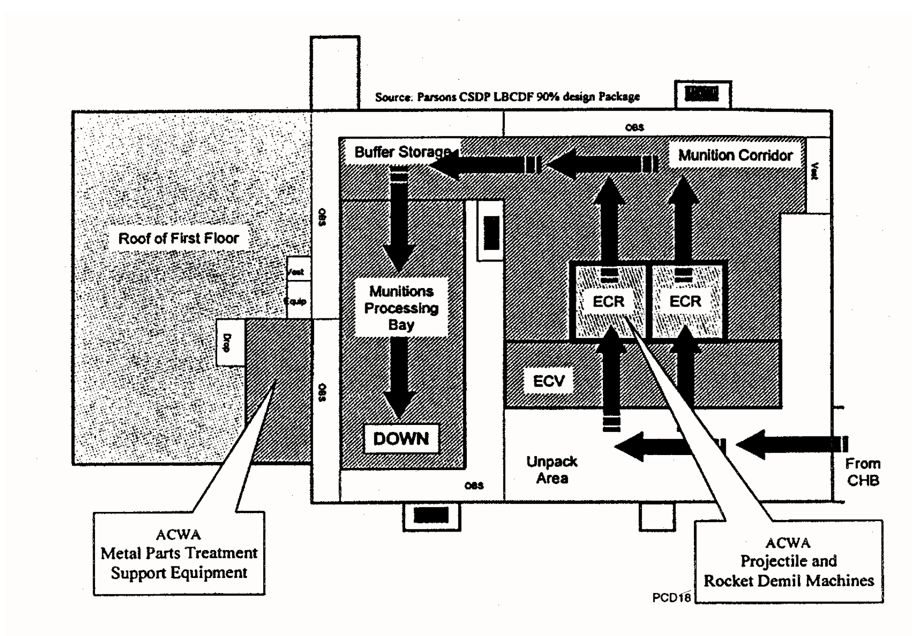


Figure E.13. Layout of biotreatment operation of Neutralization/Biotreatment Facility at PCD (*Source:* Parsons/Allied Signal 1999).

shows the layout of the second floor, and Figure E.13 shows the layout for the biotreatment operation. The biotreatment units would be physically located outside the two-story building.

E.3.2.2 Operations Inputs and Resource Requirements

At full-scale operation, destruction of the mustard agent inventory at PCD is projected to require 731 days (Mitretek 2001a). Assuming 276 operating days per year, destruction operations would require about 32 calendar months (PMACWA 1999b). The technology provider, however, estimates an operation duration of about 159 weeks, or about 37 months (Parsons/Allied Signal 1999).38 This duration is based on a 12-hours-per shift, 6-days-perweek operation, 46 weeks per year.

Table E.5 gives the annual utility consumption for facility operation, including electricity, fuel, and potable water usage. Process water requirements could not be ascertained from the information supplied by the technology provider. A qualitative assessment, however, indicates that there are no expected exceptional requirements. Water recovery and recycling may further mitigate water use.

Table E.5. Estimated utilities consumed during destruction of ACW at the Neutralization/Biotreatment Facility at PCD

Utility	Average daily consumption	Peak-day consumption	Annual consumption
Process water[a]	21,000 gal/d	480 gal/min	5,700,000 gal/yr[c]
Potable water[b]	17,500 gal/d	180 gal/min	6,400,000 gal/yr[c]
Fire water[b]	NA[d]	3,000 gal/min	NA
Sanitary sewer[b]	20,650 gal/d	395 gal/min	7,500,000 gal/yr[c]
Natural gas[a]	340,000 scf/h	27,000 scf/h	94,000,000 scf/yr[e]
Fuel oil	962 gal/d	406 gal/h	48,000 gal/yr[f]
Electricity	98 MWh	4.8 MW	35.7 GWh[c,g]

[a]Estimated based on the ratio of the mustard agent processing rate at PCD to that at the Aberdeen Chemical Agent Disposal Facility.

[b]Assumed to be similar to incineration because the number of operations and maintenance personnel and the land area are unchanged from incineration.

[c]Based on 365 days per year.

[d]NA-not applicable.

[e]Based on 276 days of operation a year.

[f]Estimated on the basis of 600 hours of emergency diesel generator operation per year.

[g]Based on an annual power rating of 80%.

Source: COE (1987); TRD Table 4.39; and private communication (e-mail from Penny Robitaille, PMCD, to Tim Ensminger, ORNL, dated Dec. 19, 2001).

E.3.2.3 Operations Emissions and Waste Estimates

Wastes from the neutralization/biotreatment process would include air emissions and solid wastes. According to the technology provider, the only liquid effluent expected from the facility would be sanitary waste. All liquids generated by the agent neutralization/biotreatment process and all liquid laboratory wastes would be disposed of internally by neutralization/ biotreatment. Disposal facility operations, including waste management, would comply with U.S. Army, federal, state, and local requirements. Any wastes that are identified as hazardous would be stored and disposed of in accordance with RCRA requirements. A summary of the types of emissions and solid wastes is provided below.

Atmospheric Emissions. Atmospheric emissions generated by facility operation would originate from the facility neutralization units, the ICB units, the process area carbon filtration/HEPA filter system, steam boilers, and vehicles; from airborne dust from handling of solid residues; and from vehicular traffic. Handling and disposal of biotreatment residue in accordance with the provisions of RCRA would result in little potential for significant adverse impacts on air quality. Emissions from vehicles and combustion of natural gas and LPG are regulated by the EPA and the State of Colorado and also would result in little potential for significant adverse impacts on air quality. Dust emissions would be controlled during operations as well.

The process would be required to meet RCRA requirements and would operate under permit. The neutralization/biotreatment system would be required to destroy agent to a DRE of 99.9999% and to meet agent emission limits as established by the ASG. Other emissions, including metals and HCl, would be regulated in accordance with the RCRA permit. The units also would be required to meet air pollution control requirements for conventional pollutants, such as CO, SO2, and opacity.

All ventilation air would be processed through carbon filtration units before release to the atmosphere, except for that associated with the biotreatment units. Process off-gas from the various unit operations, including the biotreatment units, would be passed through catalytic converters (CatOx system) to oxidize compounds of concern. Facility effluent release points would include gaseous releases to the environment.

Table E.6 summarizes the estimated emission rates of criteria pollutants during operations. These rates were estimated on the basis of normal biotreatment operations. Daily emission rates can be estimated from the hourly rates, on the basis of the assumption that there are 12 operating hours per day.

The neutralization/biotreatment facility at PCD would be equipped with building ventilation systems that would discharge, to the atmosphere, indoor air from the MDB process area, the Laboratory Building, and the Personnel and Maintenance Building through the filter farm stack. Of these three discharges, only the indoor air from the MDB process area would be potentially exposed to chemical agents during operations.

To estimate the maximum potential emissions of chemical agents, only the MDB process area is considered to be a significant potential source. The filter systems would be designed to remove chemical agents from the ventilation air streams to levels below the allowable stack concentrations that have been recommended by the U.S. Department of Health and Human Services, Centers for Disease Control (53 *Federal Register* 8504-8507, March 15, 1988). Estimated potential chemical agent emission rates are given in Table E.7; the estimates were based on the assumption that the chemical agent concentrations in the air discharged from the filter farm stack would be at 20% of the recommended allowable stack concentrations (i.e., the level of quantification of the ventilation exhaust chemical agent monitors.)

Table E.6. Estimated hourly and annual emission rates of criteria pollutants during normal Neutralization/Biotreatment operations at PCD

	Process steam boiler[a]		Diesel generator exhaust[b]	
Criteria pollutant	lb/h	tons/yr	lb/h	tons/yr
CO	2.4	3.95	10.4	3.12
NO_x	4.0	6.58	48.4	14.50
SO_2	0.02	0.03	3.2	0.95
PM_{10}	0.22	0.36	3.4	1.02
VOCs	0.16	0.26	4.0	1.18

[a]Estimated from the daily requirement of process steam.
[b]Based on 600 hours of operations per year
Source: APG (1997); TRD Table 4.43

Table E.7. Estimated maximum hourly and annual (total) agent emission rates from the filter farm stack during Neutralization/Biotreatment at PCD

Chemical agent	Emission factor (mg/m^3)[a]	Stack exit gas flow (acfm)[b]	Hours of operation per year[c]	Stack emission rate (lb/h)	Stack emission rate (tons/yr)[d]
HD, HT	0.006	96,000	3,312	2.2E-03	3.6E-03

[a]Based on the monitor level of quantification, which is 20% of the allowable stack concentration recommended for each chemical agent in 53 CFR 8504-8507.
[b]Filter farm stack exit flow based on building ventilation for the MDB.
[c]Hours of operations based on the assumption that each pilot plant operates at the design throughputs specified in CBDCOM (1997).
[d]Estimate based on number of hours of operation per year.
Source: TRD Table 4.46.

Liquid Wastes. As indicated previously, liquids from the biotreatment would be evaporated, condensed, and reused. Other liquids, such as spent decontamination solutions and laboratory wastes, would be fed to the neutralization/biotreatment system. According to the technology provider, domestic sewage is the only liquid effluent expected to be generated at the facility in major quantities. Small amounts of hazardous liquids could be generated from chemical makeup and reagents for support activities; it is anticipated that the quantities may be minor compared with those for domestic sewage (sanitary waste). Sanitary wastes would be managed on-site.

Solid Wastes. Solid wastes generated by the facility would consist primarily of biosolids and salts. Biosolids are the solid effluent from the bioreactor system; this effluent consists of microbial biomass and absorbed metals, grit, and dirt. Brine salts would result from the hydrolysis process, facility washdown, and biotreatment. The salts would contain metals derived from ACW components and would be disposed of as hazardous waste in a RCRA-permitted landfill. The sludge generated in the iotreatment system would be removed in the sludge treatment systems downstream of the ICB. The sludge would be separated from the water by means of a clarifier and would be dewatered and compacted by means of a filter press. Drummed filter cake would then be disposed of as hazardous waste in a RCRA-permitted facility.

Nonhazardous scrap metal from the munition bodies (5X condition) would be sold to a scrap dealer or smelter for reuse if approved by the regulatory. However, if it proves necessary, these metals could be disposed of off-site in a nonhazardous waste landfill or a RCRA-permitted hazardous waste landfill. Currently, the U.S. Army does not intend to dispose of any waste materials from the destruction process on-site.

Nonprocess waste streams include decon solution, DPE suits, spent carbon, waste oils, trash, debris, and spent hydraulic fluid, which are assumed to be potentially agent-contaminated and would be processed in the dunnage/waste processing system. After this processing, the only streams with a significant solid residue would be the decontamination solution (containing NaOH and NaOCl) and miscellaneous metal parts from equipment operation.

E.4 REFERENCES

Aberdeen Proving Ground, 1997, Application for Permit to Construct the U.S. Army Aberdeen Proving Ground Chemical Agent Disposal Facility, Volume I, Aberdeen Proving Ground, Md., May.

Edgewood Research, Development, and Engineering Center, 1996, HD Hydrolysis/Biodegradation Toxicology and Kinetics, ERDEC-TR-382, U.S. Army Edgewood Research Development and Engineering Center, Aberdeen Proving Ground, Md., Dec.

General Atomics, 1999, Assembled Chemical Weapons Assessment (ACWA) Draft Test Technical Report, San Diego, Calif., June.

Mitretek Systems, Inc, 2001a, Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Parsons/ Honeywell Neutralization/Biotreatment Process, McClean, Va., May.

Mitretek Systems, Inc., 2001b, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the General Atomics Neutralization/Supercritical Water Oxidation Proces*s, McClean, Va., May.

Newman, K.E., 1999, *A Review of Alkaline Hydrolysis of Energetic Materials: Is it Applicable to Demilitarization of Ordnance*?, Report IHTR 2167, Naval Surface Warfare Center Indian Head Division, Indian Head, Md. (as cited by NRC 1999).

Newport Chemical Depot, 1998a, *Application for Permit to Construct the U.S. Army Newport Chemical Depot Chemical Agent Disposal Facilit*y, Newport Chemical Depot, Ind., March.

Newport Chemical Depot, 1998b, *National Pollutant Discharge Elimination System Permit Application for the Department of the Army, Newport Chemical Depot, Newport Chemical Demilitarization Facilit*y, Newport Chemical Depot, Ind., May.

National Research Council, 1998, *Using Supercritical Water Oxidation to Treat Hydrolysate from VX Neutralization,* Committee on Review and Evaluation of the U.S. Army Chemical Stockpile Disposal Program, Board on Army Science and Technology, National Academy Press, Washington, D.C., Sept.

National Research Council, 1999, *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapon*s, Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons, National Academy Press, Washington, D.C., Sept.

Parsons/Allied Signal, 1999, *Assessment of Technologies for Assembled Chemical Weapons Demilitarization, Demonstration Test Final Repor*t, Pasadena, Calif., July.

Program Manager for Assembled Chemical Weapons Assessment, 1999a, *Final Technical Evaluation Repor*t, U.S. Department of Defense, PMACWA, Aberdeen Proving Ground, Md., Sept.

Program Manager for Assembled Chemical Weapons Assessment, 1999*b, Supplemental Report to Congress, Assembled Chemical Weapons Assessment Progra*m, U.S. Department of Defense, PMACWA, Aberdeen Proving Ground, Md., Sept.

Program Manager for Chemical Demilitarization, 1997, *Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas, Revised Final Environmental Impact Statemen*t, U.S. Army, PMCD, Aberdeen Proving Ground, Md., Nov.

Program Manager for Chemical Demilitarization, 1998a, *Final Environmental Impact Statement for Pilot Testing of Neutralization/Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland,* U.S. Army, PMCD, Aberdeen Proving Ground, Md., July.

Program Manager for Chemical Demilitarization, 1998b, *Final Environmental Impact Statement for Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana,* U.S. Army, PMCD, Aberdeen Proving Ground, Md., Dec.

APPENDIX F

CONSULTATION LETTERS

F.1 ENDANGERED SPECIES

Exhibit F.1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Colorado Field Office
755 Parfet Street, Suite 361
Lakewood, Colorado 80215

IN REPLY REFER TO:
ES/CO: Species List
MS 65412 LK

MAY 9 2000

Edwin D. Pentecost, PhD
Environmental Assessment Division
Argonne National Laboratory
9700 South Cass Avenue, Building 900
Argonne, Illinois 60439

Dear Mr. Pentecost:

In response to your letter of April 24, 2000, the U.S. Fish and Wildlife Service (Service) is providing the list of Federally listed species requested for the proposed plans to destroy chemical agent and munitions stored at Pueblo Chemical Depot located in Pueblo County, Colorado. This list and comments should be helpful in your preparation of the environmental evaluation of the project area. These comments have been prepared under the provisions of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et. seq.).

The following is the list of the Federally listed threatened and endangered species that could occur at or visit the subject counties:

Birds:	Bald eagle, *Haliaeetus leucocephalus*, Threatened Whooping crane, *Grus americana*, Endangered Mountain plover, *Charadrius montanus*, Proposed Threatened Mexican spotted owl, *Strix occidentalis lucida*, Threatened
Mammals:	Black-footed ferret, *Mustela nigripes*, Endangered Canada lynx, *Lynx canadensis*, Threatened
Plants:	Colorado butterfly plant, *Gaura neomexicana* spp. *coloradensis*, Proposed Threatened

The Service also is interested in the protection of species which are candidates for official listing as threatened or endangered (Federal Register, Vol. 56, No. 225, November 21, 1991; Vol. 55, No. 35, February 21, 1990). While these species presently have no legal protection under the ESA, it is within the spirit of this Act to consider project impacts to potentially sensitive candidate species. It is the intention of the Service to protect these species before human-related activities adversely impact their habitat to a degree that they would need to be listed and, therefore, protected under the ESA. Additionally, we wish to make you aware of the presence of Federal candidates should any be proposed or listed prior to the time that any or all Federal actions related to the project are completed. If any candidate species will be unavoidably impacted, appropriate mitigation should be proposed and discussed with this office.

Exhibit F.1 (Continued)

Page 2

The list of Federal candidate species that could occur at or visit the proposed site include:

Mammals: Swift fox, *Vulpes velox*, Candidate
Black-tailed prairie dog, *Cynomys ludovicianus*, Candidate

Fish: Arkansas darter, *Etheostoma cragini*, Candidate

If the Service can be of further assistance, contact Clay Ronish of this office at (303) 275-2370.

Sincerely,

LeRoy W. Carlson

LeRoy W. Carlson
Colorado Field Supervisor

cc: Reading file
Project file

Reference: Clay.speclist.03.00

Exhibit F.2

ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE, BUILDING 900, ARGONNE, ILLINOIS 60439 TELEPHONE: 630/252-8849

April 24, 2000

Mr. John Mumma, Director
Colorado Division of Wildlife
6060 Broadway
Denver, CO 80216

Dear Mr. Mumma:

The Department of Army, Assembled Chemical Weapons Assessment Program and the Chemical Demilitarization Program are preparing two environmental impact statements concerning its plans to destroy chemical agent and munitions stored at Pueblo Chemical Depot (PCD) located in Pueblo County, Colorado, approximately 14 mi East of Pueblo. The first EIS will evaluate four different technologies and the no action for destruction of chemical agent and munitions stored at PCD. The second EIS will address the impacts of constructing and operating an incinerator at PCD to dispose of chemical agent. I've included a map showing the location of the PCD and copies of the Federal Register notices for both projects for your use.

We would appreciate receiving information on any state-protected species that may inhabit or visit the PCD and could possibly be affected by construction of demonstration facilities or an incinerator. The plant facilities would likely disturb about 20 acres of short-grass or greasewood scrub habitat in the northeast corner of PCD. Infrastructure upgrades to power lines, a new substation, water, gas and telecommunication lines and access roads would disturb an estimated additional 20 acres in these same areas. As part of the analysis of ecological impacts we will assess potential impacts to state-listed endangered, threatened, and sensitive species. We will also address potential impacts to sensitive plant communities that may occur at PCD. A list of these species and their residency status at PCD or in the vicinity would be useful for the analysis.

Thank you in advance for your assistance.

Sincerely,

Edwin D. Pentecost

Edwin D. Pentecost, PhD
Environmental Assessment Division

Encl.
cc: B. Goforth, CDOW
M. Konishi, CDOW

Exhibit F.2 (Continued)

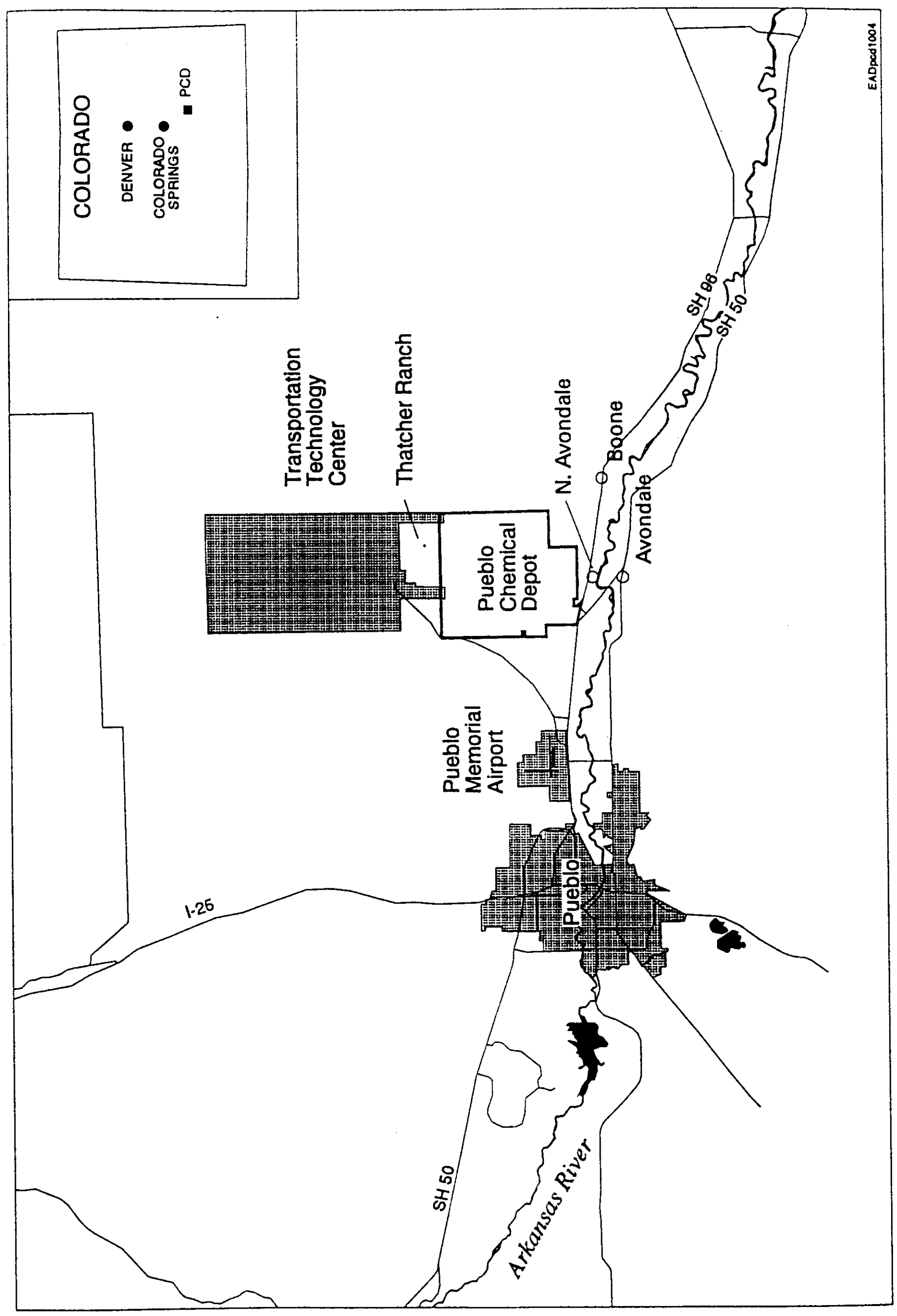


FIGURE 3.1-1 Location of Pueblo Chemical Depot

Exhibit F.2 (Continued)

Federal Register / Vol. 65, No. 73 / Friday, April 14, 2000 / Notices 20139

Dated: April 10, 2000.

Craig Johnson,

Acting Chief, Endangered Species Division, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 00–9351 Filed 4–13–00; 8:45 am]

BILLING CODE 3510–22–F

DEPARTMENT OF DEFENSE

Department of the Army

Environmental Impact Statement for Follow-On Tests Including Design, Construction and Operation of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites

AGENCY: Program Manager, Assembled Chemical Weapons Assessment, Department of Defense.

ACTION: Notice of intent.

SUMMARY: This announces the Army's intent to prepare an Environmental Impact Statement on the potential impacts of the design, construction and operation of one or more pilot test facilities for assembled chemical weapon destruction technologies at one or more chemical weapons stockpile sites, potentially simultaneously with any existing demilitarization programs and schedules at these sites. The size of the pilot tests and the location of the test facilities will be determined in this process.

DATES: Written comments must be received not later than May 30, 2000 in order to be considered in the Draft Environmental Impact Statement.

ADDRESSES: Written comments may be forwarded to the Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E–5101, Room 219, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010–5424.

FOR FURTHER INFORMATION CONTACT: Ms. Ann Gallegos at 410–436–4345, by fax at 410–436–5297, or via email at ann.gallegos@sbccom.apgea.army.mil, or Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E–5101, Room 212, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010–5424.

SUPPLEMENTARY INFORMATION: This proposed action continues the process that began when Congress established the Assembled Chemical Weapons Assessment Program through passage of Public Law 104–208. The authorizing legislation instructed the Department of Defense to identify and demonstrate alternatives to baseline incineration for the destruction of assembled chemical weapons. Baseline incineration is the technology and process in place at the Johnston Atoll in the Pacific and at Deseret Chemical Depot in Utah. Assembled chemical weapons are munitions containing both chemical agents and explosives that are stored in the United States unitary chemical weapons stockpile. This includes rockets, projectiles, and mines. Unitary agents include chemical blister agents (*e.g.*, the mustard H, HD, and HT) and chemical nerve agents (*e.g.*,GB (Sarin) and VX).

With the National Defense Appropriations Act for Fiscal Year 1999, Congress directed the Program Manager, Assembled Chemical Weapons Assessment to plan for the pilot testing of alternatives technologies.

While all of the chemical stockpile sites were initially believed to be potential test sites, Edgewood Chemical Activity in Maryland, Newport Chemical Depot in Indiana, and Johnston Atoll in the Pacific Ocean have been eliminated from any consideration. Chemical stockpile sites at Edgewood and Newport will not be considered because no assembled chemical weapons are at those locations. Johnston Atoll will not be considered because all chemical weapons at the site will be destroyed before the National Environmental Policy Act analysis can be completed.

Sites at Anniston Chemical Activity in Alabama, Pine Bluff Chemical Activity in Arkansas, Pueblo Chemical Depot in Colorado, and Blue Grass Chemical Activity in Kentucky are being considered. Deseret Chemical Depot in Utah and Umatilla Chemical Depot in Oregon are not currently being considered because the current schedule for those plants indicates that the assembled chemical weapons will be destroyed prior to the time that a pilot facility would be ready to operate. If new information indicates that assembled chemical weapons in sufficient quantity will remain at these sites, then placement of the pilot facility at those sites will be analyzed.

Technologies under consideration include a variety of processes, such as, chemical neutralization, biological treatment, and supercritical water oxidation. The Program Manager, Assembled Chemical Weapons Assessment pilot tests will not halt or delay the operation or construction of any baseline incineration facility currently in progress. Transportation of assembled chemical weapons between stockpile sites is precluded by public law and will not be considered.

Alternatives that will be considered in the Environmental Impact Statement are: (a) No action, (b) pilot test of chemical neutralization followed by super critical water oxidation, and (c) pilot test of chemical neutralization followed by biological treatment.

There is a second Notice of Intent, entitled "Notice of Intent to Prepare an Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot, Colorado." The focus of this complementary Environmental Impact Statement will be specifically on what technology should be used for the destruction of the chemical weapons stockpile at Pueblo Chemical Depot. The focus of the Assembled Chemical Weapons Assessment Environmental Impact Statement is on whether or not pilot testing of any Assembled Chemical Weapons Assessment technology should be conducted, and if so where, but it will leave to the Pueblo Chemical Depot Environment Impact Statement the question whether a full-scale facility operated initially as a pilot facility should be constructed to destroy the stockpile at that location. The emphasis for the Assembled Chemical Weapons Assessment document is to consider Assembled Chemical Weapons Assessment technologies and the various stockpile sites that may be suitable for conducting pilot tests, considering such factors as existing facilities, resource requirements for each technology and the ability of the site to provide those resources, munitions configurations and availability at each site at the time actual testing would begin. At the conclusion of both these Environmental Impact Statements, the same officials will issue The Records of Decision.

During scoping meetings, the Program Manager, Assembled Chemical Weapons Assessment is seeking to identify significant issues related to the proposed action. The Program Manager, Assembled Chemical Weapons Assessment desires information on: (1) The potential chemical weapons stockpile sites and surrounding areas, (2) concerns regarding the testing and/or operation of multiple technologies at these sites, (3) issues regarding the scale of the pilot test facilities, and (4) specific concerns regarding any potential technologies. Individuals or organizations may participate in the scoping process by written comment or by attending public meetings to be held in Alabama, Arkansas, Colorado, Kentucky and the Washington, DC metropolitan area. The dates, times, and locations of these meetings will be

Exhibit F.2 (Continued)

20140 Federal Register / Vol. 65, No. 73 / Friday, April 14, 2000 / Notices

provided at least 15 days in advance by public notices in the news media serving the regions where the meeting will be located. The public meeting in Colorado will be held in conjunction with the public meeting on the site-specific Environmental Impact Statement.

Dated: April 10, 2000.

Raymond J. Fatz,

Deputy Assistant Secretary of the Army, (Environment, Safety, and Occupational Health) OASA (I&E).

[FR Doc. 00–9336 Filed 4–13–00; 8:45 am]

BILLING CODE 3710–08–M

DEPARTMENT OF DEFENSE

Department of the Army

Notice of Intent To Prepare an Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot, CO

AGENCY: Department of the Army, DOD.

ACTION: Notice of intent.

SUMMARY: This announces the Army's intent to prepare a site-specific Environmental Impact Statement on the potential impacts of the design, construction, and operation of a facility to destroy the mustard chemical agent and munitions stored at Pueblo Chemical Depot, Colorado. The proposed facility will be used to demilitarize the chemical agent and munitions currently stored at Pueblo Chemical Depot. The Environmental Impact Statement will examine potential environmental impacts of the following destruction facility alternatives:

a. A baseline incineration facility.

b. A full-scale facility to pilot test the single-story incineration process.

c. A full-scale facility to pilot test the alternative technology successfully demonstrated by the Assembled Chemical Weapons Assessment Program—neutralization followed by supercritical water oxidation.

d. A full-scale facility to pilot test the alternative technology successfully demonstrated by the Assembled Chemical Weapons Assessment Program—neutralization followed by biodegradation.

e. No action, an alternative which will continue the storage of the mustard agent and munitions at Pueblo Chemical Depot.

To fulfill the need for destruction of the chemical weapons stockpile at Pueblo Chemical Depot in time to meet the requirements of the Chemical Weapons Convention, a pilot test facility would have to be determined to be as safe as and as cost efficient as baseline incineration. It must also be capable of completing destruction of the Pueblo Chemical Depot stockpile by the later of the Chemical Weapons Convention destruction date or the date the Pueblo Chemical Depot stockpile would be destroyed if baseline incineration were used. This requirement is consistent with the requirement for certification contained in section 142 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999, Public Law 105–261.

DATES: Written comments must be received not later than May 30, 2000, in order to be considered in the Draft Environmental Impact Statement.

ADDRESSES: Written comments may be forwarded to the Program Manager for Chemical Demilitarization, Public Outreach and Information Office (ATTN: Mr. Gregory Mahall), Building E–4585, Aberdeen Proving Ground, MD 21010–4005.

FOR FURTHER INFORMATION CONTACT: Mr. Gregory Mahall at 410–436–1093, by fax at 410–436–5122, or by mail at gjamahall@sbccom-emh1.apgea.army.mil or by mail at the above listed address.

SUPPLEMENTARY INFORMATION: In compliance with the National Environmental Policy Act (40, FR parts 1500–1508), the Army will prepare an Environmental Impact Statement to assess the health and environmental impacts of the design, construction, and operation of a facility to destroy the mustard chemical agent and munitions stored at Pueblo Chemical Depot, Colorado. Public law and international treaty require the mustard chemical agent and munitions to be destroyed. This Environmental Impact Statement will analyze the impact of the various methods of destroying the Pueblo stockpile. This action is proposed in concert with an announcement to programmatically address the process for follow-on tests for assembled chemical weapons destruction technologies at one or more sites. These two separate and distinct analyses serve complementary but distinct purposes.

This site-specific Environmental Impact Statement continues the process that began when Congress established the Program for Chemical Demilitarization in Public Law 99–145 in 1985. This law requires the destruction of the chemical weapons stockpile by a deadline established by treaty. That date is April 2007. This requirement still exists, notwithstanding the establishment of the Assembled Chemical Weapons Assessment Program. The Chemical Demilitarization Program established by Public Law 99–145 published a Programmatic Environmental Impact Statement in January 1988. The Record of Decision states that the stockpile of chemical agents and munitions should be destroyed in a safe and environmentally acceptable manner by on-site incineration. Site-specific Environmental Impact Statements that tier off the Programmatic Environmental Impact Statement have been prepared for Johnston Atoll Chemical Agent Disposal System, Tooele Chemical Agent Disposal Facility, Anniston Chemical Agent Disposal Facility, Umatilla Chemical Agent Disposal Facility, and Pine Bluff Chemical Agent Disposal Facility.

The specific purpose of the current analysis is to determine the environmental impacts of the alternatives that could accomplish the destruction of the stockpile at Pueblo Chemical Depot by the required destruction date of April 2007, including the alternatives of using the technologies successfully demonstrated by the Assembled Chemical Weapons Assessment Program. In the course of the environmental impact analysis it will be determined whether construction of a full-scale plant operated initially as a pilot facility and utilizing any of the technologies successfully demonstrated in the Assembled Chemical Weapons Assessment Program is capable of destroying the stockpile at Pueblo Chemical Depot by the required destruction date (or as soon thereafter as could be achieved by constructing a destruction facility using the baseline incineration technology), and of doing so as safely as use of the baseline incineration technology. The Record of Decision, based on the 1988 Programmatic Environmental Impact Statement, does not limit or predetermine the results of this consideration, and it does not dictate the decision to be made in the Record of Decision following completion of the Environmental Impact Statement for this action at Pueblo Chemical Depot. The Army 1988 Programmatic Environmental Impact Statement will be used to cover Pueblo Chemical Depot actions in the event that an incineration technology is selected as the preferred alternative at the conclusion of the analysis of all the available alternatives.

The second document announcing the programmatic analysis for follow-on pilot testing of successful Assembled Chemical Weapons Assessment Program demonstration tests pursuant to the process established by Congress in

Exhibit F.2 (Continued)

Federal Register / Vol. 65, No. 73 / Friday, April 14, 2000 / Notices **20141**

Public Laws 10–208 and 10–261 addresses a distinct but related purpose. That purpose is to determine which technologies can be pilot tested and if so, at which site or sites. That Environmental Impact Statement will be distinct from this site-specific Environmental Impact Statement in that its emphasis will be on the feasibility of pilot testing one or more of the demonstrated and approved Assembled Chemical Weapons Assessment Program technologies considering the unique characteristics of the alternative sites, to include Pueblo Chemical Depot. The Environmental Impact Statement will not consider the use of a full-scale facility operated initially as a pilot facility at Pueblo Chemical Depot; as discussed above, this alternative will be considered in the site specific Environmental Impact Statement for Pueblo Chemical Depot. At the conclusion of both of these Environmental Impact Statements, the same officials will issue the Records of Decision.

The Army will hold scoping meetings to aid in determining the significant issues related to the proposed action which will be addressed in the Environmental Impact Statement. The scoping process will incorporate public participation, including Federal, State of Colorado, and local agencies, as well as residents within the affected environment. The dates, times, and locations of scoping meetings will be announced in appropriate news media at least 15 days prior to these meetings.

Dated: April 10, 2000.

Raymond J. Fatz,

Deputy Assistant Secretary of the Army (Environment, Safety, and Occupational Health) OASA (I&E).

[FR Doc. 00–9337 Filed 4–13–00; 8:45 am]

BILLING CODE 3710–08–M

DEPARTMENT OF DEFENSE

Department of the Navy

Notice of Intent to Prepare a Programmatic Environmental Impact Statement for Development of Ford Island at Pearl Harbor, Hawaii

AGENCY: Department of the Navy, DOD.

ACTION: Notice.

SUMMARY: Pursuant to section 102(2)(c) of the National Environmental Policy Act of 1969 (NEPA), as implemented by the Council on Environmental Quality regulations (40 CFR parts 1500–1508), the Department of the Navy (DON) announces its intent to prepare a Programmatic Environmental Impact Statement (PEIS) for the development of Ford Island at Pearl Harbor, Hawaii in order to provide needed facilities and services and deliver overall benefits to the DON at the Pearl Harbor Naval Complex. This announcement also serves as notice that public scoping meetings will be held to solicit comments in accordance with NEPA, and request input as part of the Section 106 process of the National Historic Preservation Act (NHPA) of 1966, as implemented by the Advisory Council on Historic Preservation (ACHP) regulations (36 CFR part 800). The PEIS will also address the potential impacts of the sale or lease of DON property on Oahu, as authorized by 10 USC 2814 "Special authority for the development of Ford Island, Hawaii" and 10 U.S.C. 2871 *et seq.* "Alternate Authority for the Acquisition and Improvement of Military Housing."

DATES: Two public scoping meetings will be held to receive oral and written comments on the scope of the PEIS and public input relative to historic resources. The first meeting will be held on May 2, 2000, at 7 p.m. in the Washington Middle School, 1633 South King Street, Honolulu, Hawaii. The second meeting will be held on May 4, 2000, at 7 p.m. in the Makalapa Elementary School, 4435 Salt Lake Boulevard, Honolulu, Hawaii.

FOR FURTHER INFORMATION CONTACT: Mr. Stanley Uehara (Code PLN231), Pacific Division, Naval Facilities Engineering Command, 258 Makalapa Drive, STE 100, Pearl Harbor, Hawaii 96860–3134; telephone (808) 471–9338; fax (808) 474–5909; e-mail UeharaSY@efdpac.navfac.navy.mil.

SUPPLEMENTARY INFORMATION: The proposed action is to develop Ford Island to provide needed facilities and services and deliver overall benefits to the Department of the Navy (DON) at the Pearl Harbor Naval Complex. Ford Island is a central feature in the Pearl Harbor National Historic Landmark. The PEIS will also address the potential impacts of the sale or lease of Navy property on Oahu to fund the development on Ford Island, as authorized by 10 U.S.C. 2814 "Special authority for the development of Ford Island, Hawaii" (hereafter referred to as "Ford Island legislation") and 10 U.S.C. 2871 *et seq.* "Alternate Authority for the Acquisition and Improvement of Military Housing" (hereafter referred to as the Military Housing Privatization Initiative (MFPI) legislation). The Ford Island legislation allows DON to sell or lease properties in Hawaii and use the proceeds to develop Ford Island. The MHPI legislation allows DON to sell or lease properties and use the proceeds to invest in public-private ventures to provide military housing. Properties available for potential sale or lease include: DON property at the Waikele Branch of Naval Magazine Lualualei; the golf course, family housing, and related property at the former Naval Air Station Barbers Point; family housing and related property at Iroquois Point/Puuloa; property on Pearl Harbor mainside; and property on Ford Island. In addition to the Ford Island and MHPI legislation, other existing authorities could be used such as construction using traditional Military Construction or Non-appropriated Funds.

Due to the variety of actions envisioned for Ford Island, a PEIS is appropriate to provide an overview analysis of the affected environment and the potential cumulative impacts of reasonably foreseeable actions. Additional NEPA documentation may subsequently be required as specific projects are identified to meet the development objectives. The DON is considering adaptive reuse of existing structures on Ford Island and new construction to meet such facility requirements as: administrative and operational facilities, family and bachelor housing, transient lodging, support and commercial services, and infrastructure. Development could include filling some tidelands to construct a breakwater and/or marina. In addition to these requirements, approximately 75 acres on Ford Island could be made available for compatible commercial ventures. The purpose of developing Ford Island is to allow the DON to centralize operations for overall efficiency; to improve the quality of life for service members by improving work and leisure facilities and reducing commuting distances; and to reduce maintenance costs and congestion at mainside by replacing antiquated and obsolete facilities. Development of some portions of Ford Island is constrained by existing facilities, historic resources, and operational requirements.

Alternatives to be considered in the PEIS will be potential land development options comprising various levels of land-use for Ford Island that are consistent with the development objectives. The DON will solicit input from private sector developers through a Request for Expressions of Interest in order to obtain their expertise in developing land-use alternatives. Any reasonable alternatives to DON's land-use concept will be considered, as will comments received from federal and state agencies, non-governmental organizations and the public during the scoping process.

Exhibit F.3

ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE, BUILDING 900, ARGONNE, ILLINOIS 60439 TELEPHONE: 630/252-8849

April 24, 2000

Mr. Leroy Carlson
U.S. Fish and Wildlife Service
Ecological Services, CFO
P.O. Box 25486, DFC
Denver, CO 80225-0046

Dear Mr. Carlson:

The Department of Army, Assembled Chemical Weapons Assessment Program and the Chemical Demilitarization Program are preparing two environmental impact statements concerning its plans to destroy chemical agent and munitions stored at Pueblo Chemical Depot (PCD) located in Pueblo County, Colorado, approximately 14 mi East of Pueblo. The first EIS will evaluate four different technologies and the no action for destruction of chemical agent and munitions stored at PCD. The second EIS will address the impacts of constructing and operating an incinerator at PCD to dispose of chemical agent. I've included a map showing the location of the PCD and copies of the Federal Register notices for both projects for your use.

We would appreciate receiving information on any federally-protected species that may inhabit or visit the PCD and could possibly be affected by construction of demonstration facilities or an incinerator. The plant facilities would likely disturb about 20 acres of short-grass or greasewood scrub habitat in the northeast corner of PCD. Infrastructure upgrades to power lines, a new substation, water, gas and telecommunication lines and access roads would disturb an estimated additional 20 acres in these same areas. As part of the analysis of ecological impacts we will assess potential impacts to federally endangered, threatened, and candidate species. A list of these species and their residency status at PCD or in the vicinity would be useful for the analysis.

Thank you in advance for your assistance.

Sincerely,

Edwin D. Pentecost

Edwin D. Pentecost, PhD
Environmental Assessment Division

Encl.
cc: K. Max Canestorp, Colorado FWAO

Exhibit F.3 (Continued)

Affected Environment PCD 3/31/2000

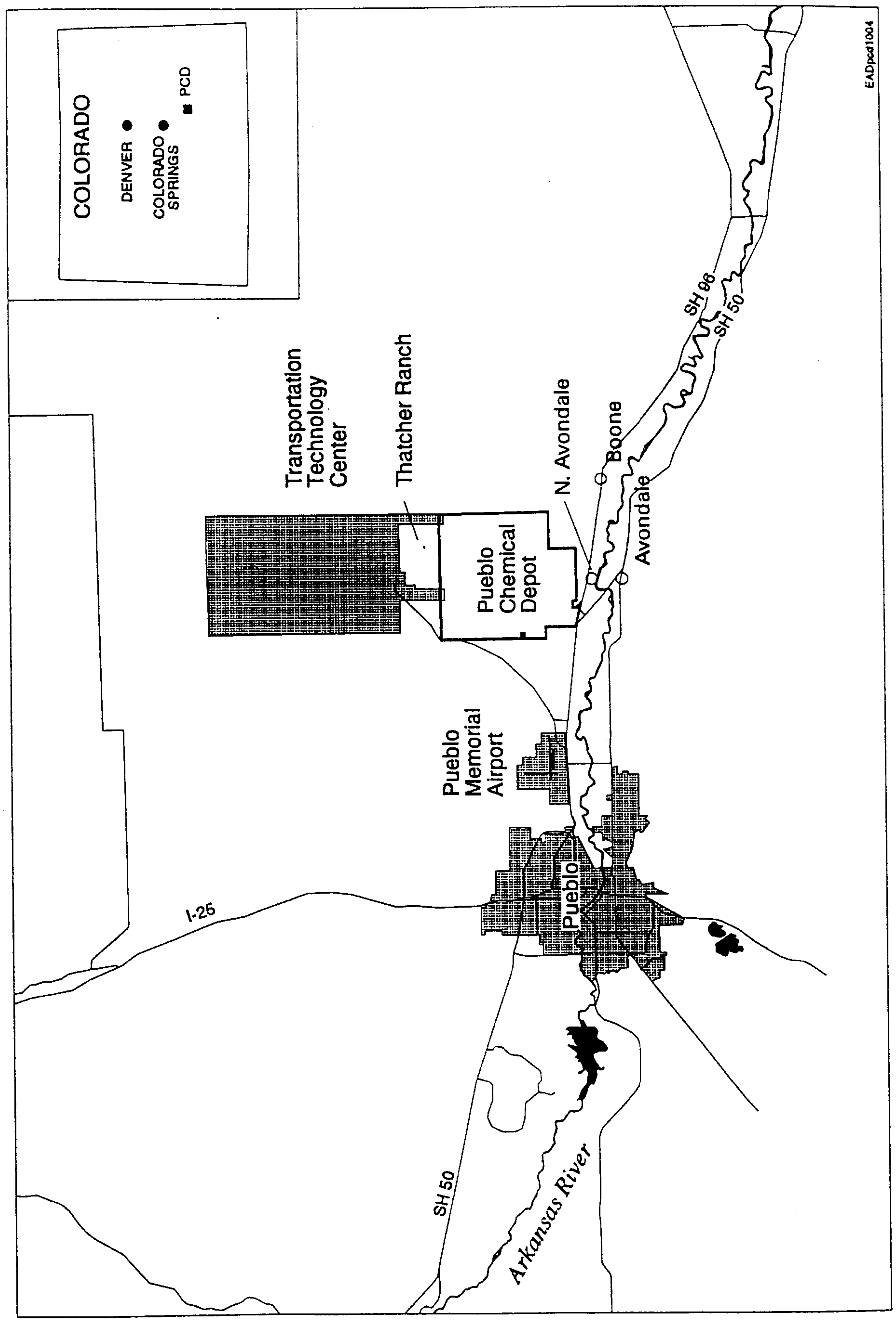


FIGURE 3.1-1 Location of Pueblo Chemical Depot

2

Exhibit F.3 (Continued)

Federal Register / Vol. 65, No. 73 / Friday, April 14, 2000 / Notices 20139

Dated: April 10, 2000.

Craig Johnson,

Acting Chief, Endangered Species Division, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 00–9351 Filed 4–13–00; 8:45 am]

BILLING CODE 3510–22–F

DEPARTMENT OF DEFENSE

Department of the Army

Environmental Impact Statement for Follow-On Tests Including Design, Construction and Operation of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites

AGENCY: Program Manager, Assembled Chemical Weapons Assessment, Department of Defense.

ACTION: Notice of intent.

SUMMARY: This announces the Army's intent to prepare an Environmental Impact Statement on the potential impacts of the design, construction and operation of one or more pilot test facilities for assembled chemical weapon destruction technologies at one or more chemical weapons stockpile sites, potentially simultaneously with any existing demilitarization programs and schedules at these sites. The size of the pilot tests and the location of the test facilities will be determined in this process.

DATES: Written comments must be received not later than May 30, 2000 in order to be considered in the Draft Environmental Impact Statement.

ADDRESSES: Written comments may be forwarded to the Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E–5101, Room 219, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010–5424.

FOR FURTHER INFORMATION CONTACT: Ms. Ann Gallegos at 410–436–4345, by fax at 410–436–5297, or via email at ann.gallegos@sbccom.apgea.army.mil, or Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E–5101, Room 212, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010–5424.

SUPPLEMENTARY INFORMATION: This proposed action continues the process that began when Congress established the Assembled Chemical Weapons Assessment Program through passage of Public Law 104–208. The authorizing legislation instructed the Department of Defense to identify and demonstrate alternatives to baseline incineration for the destruction of assembled chemical weapons. Baseline incineration is the technology and process in place at the Johnston Atoll in the Pacific and at Deseret Chemical Depot in Utah. Assembled chemical weapons are munitions containing both chemical agents and explosives that are stored in the United States unitary chemical weapons stockpile. This includes rockets, projectiles, and mines. Unitary agents include chemical blister agents (*e.g.*, the mustard H, HD, and HT) and chemical nerve agents (*e.g.*,GB (Sarin) and VX).

With the National Defense Appropriations Act for Fiscal Year 1999, Congress directed the Program Manager, Assembled Chemical Weapons Assessment to plan for the pilot testing of alternatives technologies.

While all of the chemical stockpile sites were initially believed to be potential test sites, Edgewood Chemical Activity in Maryland, Newport Chemical Depot in Indiana, and Johnston Atoll in the Pacific Ocean have been eliminated from any consideration. Chemical stockpile sites at Edgewood and Newport will not be considered because no assembled chemical weapons are at those locations. Johnston Atoll will not be considered because all chemical weapons at the site will be destroyed before the National Environmental Policy Act analysis can be completed.

Sites at Anniston Chemical Activity in Alabama, Pine Bluff Chemical Activity in Arkansas, Pueblo Chemical Depot in Colorado, and Blue Grass Chemical Activity in Kentucky are being considered. Deseret Chemical Depot in Utah and Umatilla Chemical Depot in Oregon are not currently being considered because the current schedule for those plants indicates that the assembled chemical weapons will be destroyed prior to the time that a pilot facility would be ready to operate. If new information indicates that assembled chemical weapons in sufficient quantity will remain at these sites, then placement of the pilot facility at those sites will be analyzed.

Technologies under consideration include a variety of processes, such as, chemical neutralization, biological treatment, and supercritical water oxidation. The Program Manager, Assembled Chemical Weapons Assessment pilot tests will not halt or delay the operation or construction of any baseline incineration facility currently in progress. Transportation of assembled chemical weapons between stockpile sites is precluded by public law and will not be considered.

Alternatives that will be considered in the Environmental Impact Statement are: (a) No action, (b) pilot test of chemical neutralization followed by super critical water oxidation, and (c) pilot test of chemical neutralization followed by biological treatment.

There is a second Notice of Intent, entitled "Notice of Intent to Prepare an Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot, Colorado." The focus of this complementary Environmental Impact Statement will be specifically on what technology should be used for the destruction of the chemical weapons stockpile at Pueblo Chemical Depot. The focus of the Assembled Chemical Weapons Assessment Environmental Impact Statement is on whether or not pilot testing of any Assembled Chemical Weapons Assessment technology should be conducted, and if so where, but it will leave to the Pueblo Chemical Depot Environment Impact Statement the question whether a full-scale facility operated initially as a pilot facility should be constructed to destroy the stockpile at that location. The emphasis for the Assembled Chemical Weapons Assessment document is to consider Assembled Chemical Weapons Assessment technologies and the various stockpile sites that may be suitable for conducting pilot tests, considering such factors as existing facilities, resource requirements for each technology and the ability of the site to provide those resources, munitions configurations and availability at each site at the time actual testing would begin. At the conclusion of both these Environmental Impact Statements, the same officials will issue The Records of Decision.

During scoping meetings, the Program Manager, Assembled Chemical Weapons Assessment is seeking to identify significant issues related to the proposed action. The Program Manager, Assembled Chemical Weapons Assessment desires information on: (1) The potential chemical weapons stockpile sites and surrounding areas, (2) concerns regarding the testing and/or operation of multiple technologies at these sites, (3) issues regarding the scale of the pilot test facilities, and (4) specific concerns regarding any potential technologies. Individuals or organizations may participate in the scoping process by written comment or by attending public meetings to be held in Alabama, Arkansas, Colorado, Kentucky and the Washington, DC metropolitan area. The dates, times, and locations of these meetings will be

Exhibit F.3 (Continued)

20140 Federal Register / Vol. 65, No. 73 / Friday, April 14, 2000 / Notices

provided at least 15 days in advance by public notices in the news media serving the regions where the meeting will be located. The public meeting in Colorado will be held in conjunction with the public meeting on the site-specific Environmental Impact Statement.

Dated: April 10, 2000.

Raymond J. Fatz,

Deputy Assistant Secretary of the Army, (Environment, Safety, and Occupational Health) OASA (I&E).

[FR Doc. 00–9336 Filed 4–13–00; 8:45 am]

BILLING CODE 3710–08–M

DEPARTMENT OF DEFENSE

Department of the Army

Notice of Intent To Prepare an Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot, CO

AGENCY: Department of the Army, DOD.

ACTION: Notice of intent.

SUMMARY: This announces the Army's intent to prepare a site-specific Environmental Impact Statement on the potential impacts of the design, construction, and operation of a facility to destroy the mustard chemical agent and munitions stored at Pueblo Chemical Depot, Colorado. The proposed facility will be used to demilitarize the chemical agent and munitions currently stored at Pueblo Chemical Depot. The Environmental Impact Statement will examine potential environmental impacts of the following destruction facility alternatives:

a. A baseline incineration facility.

b. A full-scale facility to pilot test the single-story incineration process.

c. A full-scale facility to pilot test the alternative technology successfully demonstrated by the Assembled Chemical Weapons Assessment Program—neutralization followed by supercritical water oxidation.

d. A full-scale facility to pilot test the alternative technology successfully demonstrated by the Assembled Chemical Weapons Assessment Program—neutralization followed by biodegradation.

e. No action, an alternative which will continue the storage of the mustard agent and munitions at Pueblo Chemical Depot.

To fulfill the need for destruction of the chemical weapons stockpile at Pueblo Chemical Depot in time to meet the requirements of the Chemical Weapons Convention, a pilot test facility would have to be determined to be as safe as and as cost efficient as baseline incineration. It must also be capable of completing destruction of the Pueblo Chemical Depot stockpile by the later of the Chemical Weapons Convention destruction date or the date the Pueblo Chemical Depot stockpile would be destroyed if baseline incineration were used. This requirement is consistent with the requirement for certification contained in section 142 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999, Public Law 105–261.

DATES: Written comments must be received not later than May 30, 2000, in order to be considered in the Draft Environmental Impact Statement.

ADDRESSES: Written comments may be forwarded to the Program Manager for Chemical Demilitarization, Public Outreach and Information Office (ATTN: Mr. Gregory Mahall), Building E–4585, Aberdeen Proving Ground, MD 21010–4005.

FOR FURTHER INFORMATION CONTACT: Mr. Gregory Mahall at 410–436–1093, by fax at 410–436–5122, or by mail at gjamahall@sbccom-emh1.apgea.army.mil or by mail at the above listed address.

SUPPLEMENTARY INFORMATION: In compliance with the National Environmental Policy Act (40, FR parts 1500–1508), the Army will prepare an Environmental Impact Statement to assess the health and environmental impacts of the design, construction, and operation of a facility to destroy the mustard chemical agent and munitions stored at Pueblo Chemical Depot, Colorado. Public law and international treaty require the mustard chemical agent and munitions to be destroyed. This Environmental Impact Statement will analyze the impact of the various methods of destroying the Pueblo stockpile. This action is proposed in concert with an announcement to programmatically address the process for follow-on tests for assembled chemical weapons destruction technologies at one or more sites. These two separate and distinct analyses serve complementary but distinct purposes.

This site-specific Environmental Impact Statement continues the process that began when Congress established the Program for Chemical Demilitarization in Public Law 99–145 in 1985. This law requires the destruction of the chemical weapons stockpile by a deadline established by treaty. That date is April 2007. This requirement still exists, notwithstanding the establishment of the Assembled Chemical Weapons Assessment Program. The Chemical Demilitarization Program established by Public Law 99–145 published a Programmatic Environmental Impact Statement in January 1988. The Record of Decision states that the stockpile of chemical agents and munitions should be destroyed in a safe and environmentally acceptable manner by on-site incineration. Site-specific Environmental Impact Statements that tier off the Programmatic Environmental Impact Statement have been prepared for Johnston Atoll Chemical Agent Disposal System, Tooele Chemical Agent Disposal Facility, Anniston Chemical Agent Disposal Facility, Umatilla Chemical Agent Disposal Facility, and Pine Bluff Chemical Agent Disposal Facility.

The specific purpose of the current analysis is to determine the environmental impacts of the alternatives that could accomplish the destruction of the stockpile at Pueblo Chemical Depot by the required destruction date of April 2007, including the alternatives of using the technologies successfully demonstrated by the Assembled Chemical Weapons Assessment Program. In the course of the environmental impact analysis it will be determined whether construction of a full-scale plant operated initially as a pilot facility and utilizing any of the technologies successfully demonstrated in the Assembled Chemical Weapons Assessment Program is capable of destroying the stockpile at Pueblo Chemical Depot by the required destruction date (or as soon thereafter as could be achieved by constructing a destruction facility using the baseline incineration technology), and of doing so as safely as use of the baseline incineration technology. The Record of Decision, based on the 1988 Programmatic Environmental Impact Statement, does not limit or predetermine the results of this consideration, and it does not dictate the decision to be made in the Record of Decision following completion of the Environmental Impact Statement for this action at Pueblo Chemical Depot. The Army 1988 Programmatic Environmental Impact Statement will be used to cover Pueblo Chemical Depot actions in the event that an incineration technology is selected as the preferred alternative at the conclusion of the analysis of all the available alternatives.

The second document announcing the programmatic analysis for follow-on pilot testing of successful Assembled Chemical Weapons Assessment Program demonstration tests pursuant to the process established by Congress in

Exhibit F.3 (Continued)

Federal Register / Vol. 65, No. 73 / Friday, April 14, 2000 / Notices 20141

Public Laws 10–208 and 10–261 addresses a distinct but related purpose. That purpose is to determine which technologies can be pilot tested and if so, at which site or sites. That Environmental Impact Statement will be distinct from this site-specific Environmental Impact Statement in that its emphasis will be on the feasibility of pilot testing one or more of the demonstrated and approved Assembled Chemical Weapons Assessment Program technologies considering the unique characteristics of the alternative sites, to include Pueblo Chemical Depot. The Environmental Impact Statement will not consider the use of a full-scale facility operated initially as a pilot facility at Pueblo Chemical Depot; as discussed above, this alternative will be considered in the site specific Environmental Impact Statement for Pueblo Chemical Depot. At the conclusion of both of these Environmental Impact Statements, the same officials will issue the Records of Decision.

The Army will hold scoping meetings to aid in determining the significant issues related to the proposed action which will be addressed in the Environmental Impact Statement. The scoping process will incorporate public participation, including Federal, State of Colorado, and local agencies, as well as residents within the affected environment. The dates, times, and locations of scoping meetings will be announced in appropriate news media at least 15 days prior to these meetings.

Dated: April 10, 2000.

Raymond J. Fatz,

Deputy Assistant Secretary of the Army (Environment, Safety, and Occupational Health) OASA (I&E).

[FR Doc. 00–9337 Filed 4–13–00; 8:45 am]

BILLING CODE 3710–08–M

DEPARTMENT OF DEFENSE

Department of the Navy

Notice of Intent to Prepare a Programmatic Environmental Impact Statement for Development of Ford Island at Pearl Harbor, Hawaii

AGENCY: Department of the Navy, DOD.

ACTION: Notice.

SUMMARY: Pursuant to section 102(2)(c) of the National Environmental Policy Act of 1969 (NEPA), as implemented by the Council on Environmental Quality regulations (40 CFR parts 1500–1508), the Department of the Navy (DON) announces its intent to prepare a Programmatic Environmental Impact Statement (PEIS) for the development of Ford Island at Pearl Harbor, Hawaii in order to provide needed facilities and services and deliver overall benefits to the DON at the Pearl Harbor Naval Complex. This announcement also serves as notice that public scoping meetings will be held to solicit comments in accordance with NEPA, and request input as part of the Section 106 process of the National Historic Preservation Act (NHPA) of 1966, as implemented by the Advisory Council on Historic Preservation (ACHP) regulations (36 CFR part 800). The PEIS will also address the potential impacts of the sale or lease of DON property on Oahu, as authorized by 10 USC 2814 "Special authority for the development of Ford Island, Hawaii" and 10 U.S.C. 2871 *et seq.* "Alternate Authority for the Acquisition and Improvement of Military Housing."

DATES: Two public scoping meetings will be held to receive oral and written comments on the scope of the PEIS and public input relative to historic resources. The first meeting will be held on May 2, 2000, at 7 p.m. in the Washington Middle School, 1633 South King Street, Honolulu, Hawaii. The second meeting will be held on May 4, 2000, at 7 p.m. in the Makalapa Elementary School, 4435 Salt Lake Boulevard, Honolulu, Hawaii.

FOR FURTHER INFORMATION CONTACT: Mr. Stanley Uehara (Code PLN231), Pacific Division, Naval Facilities Engineering Command, 258 Makalapa Drive, STE 100, Pearl Harbor, Hawaii 96860–3134; telephone (808) 471–9338; fax (808) 474–5909; e-mail UeharaSY@efdpac.navfac.navy.mil.

SUPPLEMENTARY INFORMATION: The proposed action is to develop Ford Island to provide needed facilities and services and deliver overall benefits to the Department of the Navy (DON) at the Pearl Harbor Naval Complex. Ford Island is a central feature in the Pearl Harbor National Historic Landmark. The PEIS will also address the potential impacts of the sale or lease of Navy property on Oahu to fund the development on Ford Island, as authorized by 10 U.S.C. 2814 "Special authority for the development of Ford Island, Hawaii" (hereafter referred to as "Ford Island legislation") and 10 U.S.C. 2871 *et seq.* "Alternate Authority for the Acquisition and Improvement of Military Housing" (hereafter referred to as the Military Housing Privatization Initiative (MFPI) legislation). The Ford Island legislation allows DON to sell or lease properties in Hawaii and use the proceeds to develop Ford Island. The MHPI legislation allows DON to sell or lease properties and use the proceeds to invest in public-private ventures to provide military housing. Properties available for potential sale or lease include: DON property at the Waikele Branch of Naval Magazine Lualualei; the golf course, family housing, and related property at the former Naval Air Station Barbers Point; family housing and related property at Iroquois Point/Puuloa; property on Pearl Harbor mainside; and property on Ford Island. In addition to the Ford Island and MHPI legislation, other existing authorities could be used such as construction using traditional Military Construction or Non-appropriated Funds.

Due to the variety of actions envisioned for Ford Island, a PEIS is appropriate to provide an overview analysis of the affected environment and the potential cumulative impacts of reasonably foreseeable actions. Additional NEPA documentation may subsequently be required as specific projects are identified to meet the development objectives. The DON is considering adaptive reuse of existing structures on Ford Island and new construction to meet such facility requirements as: administrative and operational facilities, family and bachelor housing, transient lodging, support and commercial services, and infrastructure. Development could include filling some tidelands to construct a breakwater and/or marina. In addition to these requirements, approximately 75 acres on Ford Island could be made available for compatible commercial ventures. The purpose of developing Ford Island is to allow the DON to centralize operations for overall efficiency; to improve the quality of life for service members by improving work and leisure facilities and reducing commuting distances; and to reduce maintenance costs and congestion at mainside by replacing antiquated and obsolete facilities. Development of some portions of Ford Island is constrained by existing facilities, historic resources, and operational requirements.

Alternatives to be considered in the PEIS will be potential land development options comprising various levels of land-use for Ford Island that are consistent with the development objectives. The DON will solicit input from private sector developers through a Request for Expressions of Interest in order to obtain their expertise in developing land-use alternatives. Any reasonable alternatives to DON's land-use concept will be considered, as will comments received from federal and state agencies, non-governmental organizations and the public during the scoping process.

Exhibit F.4

STATE OF COLORADO
Bill Owens, Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
AN EQUAL OPPORTUNITY EMPLOYER

John W. Mumma, Director

Pueblo Service Center:
600 Reservoir Road
Pueblo, CO 81005
(719) 561-4909

5/26/00

Edwin D. Pentecost, PhD
Argonne National Laboratory
Environmental Assessment Division
9700 South Cass Avenue
Building 900
Argonne, Illinois 60439

Dear Mr. Pentecost:

The Division of Wildlife has reviewed the proposed site for the incinerator on the Pueblo Chemical Depot. The site was visited by District Wildlife Manager, Matt Martinez and myself on 5/25/00, along with Max Canestorp of the United States Fish and Wildlife Service. The area consists of mainly mixed grass prairie and a remnant stand of grease wood shrub. No species of special concern are known to occupy the proposed site. Within the Chemical Depot, some species of concern do exist within 1 mile of the proposed incinerator site. Mountain Plover *(Charadrius montanus)* and Swift Fox *(Vulpes velox)* occupy short grass prairie ecosystems on the Pueblo Chemical Depot. Black tailed prairie dogs *(Cynomys ludovicianus)* and Burrowing Owls *(Athene cunicularia)* also exist within a short distance to the proposed site. Care should be taken not to disturb this habitat.

Reclamation of the site after the incinerator is built should include short grass prairie species for the benefit of those mentioned above. Thank you for the opportunity to comment on this proposal. If you have any questions feel free to contact officer Martinez or myself at 719-561-5300.

Sincerely,

Kevin Kaczmarek

Kevin Kaczmarek
Habitat Biologist
Area 11

F.2 HISTORIC PRESERVATION

Exhibit F.5

Colorado Historical Society
Office of Archaeology and Historic Preservation
Attention: Ms. Georgianna Contiguglia, SHPO
1300 Broadway
Denver, CO 80203

Dear Ms. Contiguglia:

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of a chemical munitions disposal facility at the Pueblo Chemical Depot (PCD) in Pueblo County, Colorado. As part of the decision-making process for this action, two parallel National Environmental Policy Act (NEPA) documents are being prepared by two Army programs to address distinct but related actions.

> The Army Assembled Chemical Weapons Assessment (ACWA) is developing a programmatic environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The ACWA will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and PCD (CO).
>
> The Army Chemical Stockpile Disposal Program (CSDP) is developing a site-specific EIS to address the impacts of constructing and operating a facility to completely dispose of the chemical munitions stockpile at PCD. The CSDP EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The enclosed maps show the location of PCD and the alternative facility footprint locations at PCD. On April 14, 2000, ACWA and CSDP issued Notices of Intent to prepare EISs for their respective actions (*Federal Register* Vol. 65, No. 73, pages 20139-20140). Combined public scoping meetings for both EISs were held on May 9, 2000 in Pueblo, Colorado.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the ACWA Programmatic EIS and will be evaluating potential impacts to cultural resources as part of their analysis. Oak Ridge National Laboratory (ORNL) is assisting with the site-specific EIS for PCD. For the ACWA EIS, an archaeologist from ANL has researched available survey documents for PCD and confirmed the completeness of the documentation record at the Depot with a file search at the Colorado Historical Society Office of Archaeology and Historic Preservation. ORNL will use the information compiled by ANL for the site-specific EIS.

We would appreciate receiving information on concerns or issues you may have regarding either proposed project. Although it appears that construction and operation of a facility (ACWA pilot or incinerator) would not affect known historic properties within PCD, we are especially interested in mitigation measures your office would recommend for various accident scenarios. The potential impact of an accident, namely the contamination of properties within an approximate 30-mile radius of PCD with chemical agent, would likely be temporary in nature, but could result in restricted access to affected eligible properties for an unknown time frame (dependent on the level of contamination). Although the evaluation of accident scenarios is required in an EIS, the likelihood of this type of accident taking place is extremely low (the probability is on the order of 10^{-8}).

If you have questions regarding either project please call

Sincerely,

APPENDIX G

INFORMATION SUPPORTING HUMAN HEALTH RISK ASSESSMENTS AT AGENT INCINERATION FACILITIES

G.1 SUMMARIES OF HUMAN HEALTH RISK ASSESSMENTS FOR PROPOSED AGENT INCINERATORS

G.1.1 Tooele, Utah

A human health screening risk assessment (A. T. Kearney, Inc. 1996) was completed in 1996 by the state of Utah for the Deseret Chemical Depot (DCD) incinerator. The DCD assessment employed a multi-chemical, multi-pathway analysis that considered human exposures to chemical emissions from the stacks at the DCD facility. The assessment included both direct and indirect exposure pathways for a list of 60 constituents of interest.

The hypothetical receptors for the analysis included (a) an adult residing at the point of maximum off-site concentrations, (b) a child residing at the same point, (c) a subsistence fisher located 40 km (25 miles) from the facility (i.e., at the nearest possible location of an adequate supply of fish), and (d) three different types and locations of farmers, including cattle and vegetable farmers. The exposure pathways included the various applicable combinations of inhalation, soil ingestion, and consumption of vegetables, fish, beef, and milk.

Emissions from the facility were predicted based upon extrapolations from measurements at the Johnston Atoll Chemical Agent Disposal System (JACADS). A modifier was also included in the analysis to account for abnormal combustion conditions that might occur during startup, shutdown, or other production upsets. Emissions during times of nonpeak performance (5% of the time for metals and particulate emissions and 20% of the time for nonmetals emissions) were assumed to be 10 times the level detected during the stack tests.

For the hypothetical adult and child residents, the subsistence fisher, and the three types of farmers, the predicted carcinogenic risks were found to be at or below the level established by U.S. Environmental Protection Agency (EPA) screening risk assessment guidelines (i.e., 1×10^{-5}), even for 30 years of incinerator operations at DCD. Similarly, the noncarcinogenic risks met or were below EPA guideline risk levels (i.e., a hazard quotient of 0.25).

G.1.2 Umatilla, Oregon

In April 1996, the state of Oregon issued a pre-trial burn health risk assessment (Ecology and Environment 1996) for the proposed chemical demilitarization facility at the Umatilla Chemical Depot (UMCD). The UMCD health risk assessment included much the same approach and many of the same assumptions as in the DCD health risk assessment. The UMCD assessment considered human exposures to chemical emissions from the stacks at the proposed UMCD facility. The assessment included both direct and indirect exposure pathways for a list of 73 constituents of interest.

The hypothetical receptors for the analysis included: (a) an adult resident, (b) a child resident, (c) a subsistence farmer, and (d) a subsistence fisher. With the exception of the subsistence fisher, the health risks were evaluated at two locations: at the point of maximum concentration and at the nearest downwind fence line. The location of the subsistence fisher was at the maximally impacted water body. The subsistence fisher was assumed to catch fish from the Umatilla River (which is predicted to be more highly impacted than the Columbia River), while residing at the most highly impacted point along the river. This point was determined to be approximately 5 km (3 miles) south of the confluence of the Umatilla and Columbia Rivers.

For the hypothetical residents and the subsistence farmer, the point of maximum concentration was used regardless of whether this location was on-site or outside the UMCD boundaries. The location of maximum airborne concentration rarely coincided with the location of maximum deposition; nevertheless, for the purposes of the health risk assessment, both concentrations were assumed to occur at the same location. Thus, maximum impact was investigated. The exposure pathways included the various applicable combinations of inhalation, soil ingestion, and consumption of above-ground and below-ground produce, fish, beef, and milk.

Emissions from the facility were predicted based upon extrapolations from measurements at JACADS. A modifier was also included in the analysis to account for abnormal combustion conditions that might occur during startup, shutdown, or other production upsets. The numerical value of this modifier was the same as described above for the DCD health risk assessment.

For the hypothetical adult and child residents, the subsistence farmer, and the subsistence fisher, the results of the UMCD health risk assessment indicate that the risks to current populations were less than the regulatory benchmarks established by the Oregon Department of Environmental Quality. At the high-impact location, risks to hypothetical residents and to the subsistence farmer were greater than the benchmarks. However, this location is only about 100 m (328 ft) from the proposed facility, and well inside the nearest depot boundary. None of the other potentially exposed populations in the vicinity of UMCD are expected to be exposed to emissions constituents at levels in excess of regulatory benchmarks.

G.1.3 Pine Bluff, Arkansas

In early 1997, the U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) issued an environmental impact risk assessment [EIRA (USACHPPM 1997)] for the proposed Pine Bluff Arsenal (PBA) facility and the existing central incineration complex (CIC) at PBA. The EIRA employs a multi-chemical, multi-pathway analysis that considers human exposure to chemical emissions from the stacks of the proposed destruction facility and the existing CIC. The analysis includes both direct and indirect exposure pathways involving inhalation; incidental ingestion of soil; and consumption of beef, milk, fish, chicken, eggs, produce, and drinking water.

Emissions from the proposed PBA facility were predicted based upon extrapolations from measurements of actual emissions at JACADS. Modifiers were also included in the analysis to account for abnormal combustion conditions that might occur during startup, shutdown, or other production upsets. Emissions from two other existing Resource

Conservation and Recovery Act (RCRA) sources at the Pine Bluff were also considered in the analysis.

A total of 86 constituents of interest were evaluated. Based on anticipated waste feed stream characteristics, the substances of concern were categorized into six general classes: (1) chemical agents and/or principal organic hazardous constituents, (2) polychlorinated dioxins and furans, (3) products of incomplete combustion, (4) metals, (5) acid gases, and (6) particulate matter.

Potential health effects were determined for four groups of people: a farmer who lives on and consumes food grown on land near PBA, a fisher who consumes fish from bodies of water near PBA, an adult resident who lives near PBA, and a child resident who lives near PBA. The subsistence farmer, adult resident, and child resident were evaluated at the maximally impacted fence line location. The subsistence fishers were assumed to catch fish from the water bodies while residing at the maximally impacted fence line location. Subsistence fishers who fished at the Arkansas River, Saline River, Bayou Bartholomew, Old River Lake, and A & A Fish Farm were assumed to consume 60 g/day of fish. The fishers who fished at Yellow Lake, Tulley Lake, and Duck Reservoirs, were presumed to be recreational fishers who consumed 32 g/day of fish while also residing at the maximally impacted fence line location.

The chronic, carcinogenic and noncarcinogenic risks were calculated for both indirect and direct exposures for the subsistence farmer, five subsistence fishers, three recreational fishers, adult resident, and child resident. Risk estimates represent the incremental probability that an individual will develop cancer over his or her lifetime as a result of exposure to a particular carcinogen. These risks are termed “excess lifetime cancer risks” and represent the additional risk, above the normal background level, of an individual developing cancer. The excess lifetime cancer risks from both indirect and direct exposures are summed and compared to EPA's benchmark value of 1×10^{-5}. An excess lifetime cancer risk of 1×10^{-5} indicates that an individual has a chance of developing cancer from exposure to the carcinogenic substance somewhere in the range from zero to one in 100,000.

Noncarcinogenic hazards are expressed as a hazard index (HI). Hazard indices are the summation of individual hazard quotients (HQ) for substances that exhibit a common systemic health effect on the liver and neurological systems. All noncarcinogenic inhalation HQs were summed for a total inhalation HI, regardless of affected target organ or system. The liver HI, neurological HI, and inhalation HI were compared to a noncarcinogenic health standard of 0.25.

In addition, the fence line resident and a hypothetical on-site worker were subjected to an acute analysis (representing a 1-hr upset condition exposure). The acute analysis collected all maximum on-site concentrations into a single receptor location. The acute hazard quotients for those substances exhibiting the same potential acute toxic endpoint were added together and compared to a benchmark value of 1.0.

The EIRA is based on a screening evaluation (Step 1) that follows the methodologies recommended in EPA's Implementation Guidance (EPA 1994). Since the Step 1 results indicated no adverse human or environmental health effects, a phased demographic specific evaluation (Step 2) was not required. For the Step 1 analysis, the combined risks from the proposed destruction facility and the existing CIC to the subsistence farmer, five subsistence fishers, three recreational fishers, an adult resident, and a child resident were below the benchmark values of 1×10^{-5} for cancer, 0.25 for non-cancer, and 1.0 for acute hazard.

G.2 A REVIEW OF THE 1994 DRAFT U.S. ENVIRONMENTAL PROTECTION AGENCY DIOXIN REASSESSMENT AND OTHER INFORMATION AVAILABLE SINCE 1989

This section compares the information base from the 1988–89 time frame—the period of publication of the Final Programmatic Environmental Impact Statement (FPEIS) for the Chemical Stockpile Disposal Project (CSDP)—with more recent studies, focusing on three areas: the improved information on human health effects of dioxin and dioxin-like compounds, new information about ambient levels of dioxin and dioxin-like compounds, and changes in the understanding of the role of incineration in the production of dioxin and dioxin-like compounds.

G.3 HEALTH EFFECTS

G.3.1 Non-Cancer Endpoints Summary

Since the publication of the FPEIS (U.S. Army 1988) in January 1988, new data on non-cancer effects, especially in monkeys and rats, have been published. These data provide evidence that developmental effects on the central nervous system can occur at much lower levels of exposure than the previous animal no observed adverse effects level (NOAEL) of 1 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$. However, no available experimental data clearly indicate how low a new no-effects level should be. During the same period, studies of four groups of human infants have been performed that suggest that 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and dioxin-like substances may cause persistent adverse effects on the developing nervous system at the high end of environmental exposure levels. However, these studies are not conclusive with respect to the hypothesis that dioxin and related compounds might be the causative agents because of methodological problems as well as concomitant exposures to other potential neurotoxicants in the case of studies which examine infants exposed via maternal fish ingestion (three groups). Other non-cancer effects identified by EPA (1994) from epidemiological studies of highly exposed humans as likely TCDD effects were judged not well-substantiated, especially at or near background levels, by EPA's Science Advisory Board (SAB) (SAB 1995). The EPA was also strongly questioned about the same issues in comments from the public (EPA 1995). Even today, most of these possible effects cannot be ruled out and need further study. A chronological presentation of information from the EPA and SAB documents is highlighted in Exhibit G.1 and summarized in ATTACHMENT E-1.

Information regarding the details of TCDD-induced effects has been gained from animal and *in vitro* studies reported after the EPA Health Assessment Document was published (EPA 1988). The most significant of the new data could support a downward revision of the non-cancer animal NOAEL, probably an order of magnitude or more in view of the 0.125 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ low observed adverse effects level (LOAEL) for developmental neurotoxicity in Rhesus monkeys (Schantz, Ferguson, and Bowman 1992; Schantz and Bowman 1989) and in view of developmental effects on the male rat reproductive system and its function (Mably et al. 1992) as well as other evidence. More animal data are needed as NOAELs are not available from these studies.

Exhibit G.1. Non-cancer endpoint position summary

Developmental and reproductive toxicity

EPA 1985: Rat litter survival indices and renal pelvis dilation low observed adverse effects level (LOAEL) = 1 $ng \cdot kg^{-1} \cdot d^{-1}$ (Murray et al. 1979).
pp. 14-11: LOAEL for rat teratogenic effects greater than or equal to 100 $ng \cdot kg^{-1} \cdot d^{-1}$.

EPA 1988: 1 $ng \cdot kg^{-1} \cdot d^{-1}$ taken as a no observed adverse effects level (NOAEL), but with reservations that it may be a LOAEL; considered "highly suspect" as NOAEL (App. C, p. 9); reference dose (RfD), RfD = 1×10^{-5} $\mu g \cdot kg^{-1} \cdot d^{-1}$ (p. 14); not sufficient evidence to link tetrachlorodibenzo-*p*-dioxin (TCDD) to human developmental toxicity.

EPA 1994: pp. 7-249–50: Male reproductive hormone effects considered causally linked to increased serum TCDD levels, based on two epidemiological studies (Egeland et al. 1994 and Roegner et al. 1991).
p. 7-253: Long-term neurological effects not seen (transient effects reported in humans); too little information to determine developmental neurotoxicity.

EPA 1995 In the Summary of Public Comments on the dioxin reassessment, several commentors noted that the study by Egeland et al. (1994) on human male reproductive hormones was technically deficient and of questionable statistical significance (i.e., none of the mean reproductive hormone levels in any of the exposed groups were out of the normal range) and that relevant human data were omitted from discussion.

SAB 1995: p. 59: It would be appropriate to reevaluate NOAEL of 1 $ng \cdot kg^{-1} \cdot d^{-1}$ [Schantz, Ferguson, and Bowman (1992) and Schantz and Bowman (1989) monkey data: LOAEL = 0.125 $ng \cdot kg^{-1} \cdot d^{-1}$; Mably et al. (1992) rat frank effects level at estimated body burden of 34 $ng \cdot kg^{-1} \cdot d^{-1}$ from acute 64 ng/kg per oral on gestation day 15]. Criticized EPA for omitting consideration of evidence for developmental neurotoxicity associated with intrauterine exposure from work of Jacobson, Jacobson, and Humphrey (1990), Gladen et al. (1988), and Rogan et al. (1986); also noted Huisman et al. (1995) report of developmental toxicity.

Immunotoxicity

EPA 1985: No information.

EPA 1988: No unequivocal cases of significant immune function alterations in humans following TCDD exposure; effects in animals seen at levels also producing other pathological and reproductive/developmental effects (App. E, p. 1; pp. 19–20).

EPA 1994: p. 7-261: Too little information to suggest definitively that TCDD, at the levels observed, is an immunotoxin in humans; p. 4-35 points out inconsistencies in human data but also methodological problems that preclude ruling out effects. Table 9-5 shows recent mouse and marmoset data on effects at body burdens equivalent to human background body burden.

EPA 1995 In Summary of Public Comments on the dioxin reassessment, various commenters noted that relevant human data demonstrating no association between serum TCDD levels and diminished immune function had been omitted (e.g., Neubert et al. 1991, Roegner et al. 1991); reliance on host resistance models criticized; use of toxicity equivalent factors (TEFs) based on immunotoxicity data from mice questioned; bias toward Ah-receptor mechanism criticized; and that Chap. 9 overstated immunotoxicity risks observed in epidemiologic studies.

Exhibit G.1. (Continued)

SAB 1995:	p. 59: the SAB agreed that sufficient data exist to suggest that immunotoxic effects could occur in humans at some dose levels, but felt (p. 60) EPA had not presented convincing evidence that background or near background exposures cause adverse immunotoxic effects in humans. Human populations have not been studied with appropriate test battery, especially the “gold standard” test for suppression of primary antibody response after immunization.
Other	
EPA 1994:	p. 7-245: Gamma glutamyl transferase increased in humans; clinical significance unknown; may not be adverse. p. 7-247: Slight increased risk of diabetes or increased fasting serum glucose in humans. p. 7-262: Thyroid function: equivocal results in human studies that have looked at endpoint; little information on production workers, none on Seveso residents. Recent small study on infants shows effects on thyroxine, thyroxine binding globulin, and thyroid stimulating hormone related to TCDDs and tetrachlorinated dibenzofurans (TCDFs) in breast milk (Pluim et al. 1993); large study also suggests effects (Sauer et al. 1994). p. 9-62: Endometriosis: Rier et al. (1993): monkey, 5 ppt in diet/4 years, body burden = 54 ng/kg (NOAEL not established) (Table 9-5); possible cytokine involvement (human in vitro and ex vivo cells) (Rier, Parsons, and Becker 1994; Zarmakoupis et al. 1995).
EPA 1995:	Summary of Public Comments (EPA 1995) on animal data presentation was generally supportive; however, the use of the Egeland et al. (1994) results on human male reproductive hormones was criticized by several commentors as being technically deficient and of questionable statistical significance. Relevant human data omitted; reliance on host resistance models criticized; use of TEFs based on immunotoxicity data from mice questioned and additivity a problem; bias toward Ah-receptor mechanism was criticized; several commentors felt Chap. 9 overstated the risks observed in epidemiologic studies.
SAB 1995:	p. 78: The SAB judged that EPA has not presented findings adequate to support a conclusion that adverse effects in humans may be occurring near current environmental exposure levels to TCDD and related compounds.

However, the findings of the draft dioxin reassessment document (EPA 1994) on likely effects in humans from epidemiological studies (e.g., alterations in male reproductive hormones, borderline risk for diabetes or prediabetic change, gamma glutamyl transferase (GGT) elevation, effects on the immune system, endrometriosis) associated with elevated TCDD levels are not well-established in the eyes of the SAB. In the case of elevated GGT levels, no convincing case was made for adverse clinical health effects being associated with the observation.

According to the SAB (1995) although it appears that dioxin and related compounds can produce immune effects at some dose level in animals, the dioxin reassessment does not provide convincing evidence to indicate that background or near background exposures have similar effects in humans. This may be due in part to omissions in the types of tests of immune function employed in the epidemiological studies and in part to the long lag time between exposure and assessment of immune system function. Animal studies showing effects at body burdens in the range of human background body burdens need replication before they can be considered well established according to the SAB (1995).

The statements in EPA (1994) regarding there being a smaller margin of exposure than previously thought, and the implication that adverse effects on human health are occurring at or near background levels are judged by the SAB (1995) not to have been convincingly demonstrated in the EPA draft dioxin reassessment report (EPA 1994).

EPA (1994) estimated that if the usual procedures were followed to set a reference dose (RfD) for TCDD, that it would be about 10^{-5} µg/d (10 pg/d), or about 10–100 times below the estimated daily intake of dioxin-like compounds. However, both EPA (1994) and SAB (1995) reject the use of an RfD because TCDD toxic equivalents (TEQs) are not like the substances for which RfDs have been used but are accumulated in the body and background levels are high enough that they need to be taken into account in evaluating the impact of incremental exposures associated with a specific source. The SAB (1995) strongly recommended that EPA develop a method for assessing the non-cancer impacts of incremental exposures.

Human studies of developmental neurotoxicity have been made on four cohorts of infants exposed transplacentally and to breast milk with elevated levels of polychlorinated biphenyls (PCBs) or dioxins, furans, and PCBs. A critical and detailed analysis of the results of all studies on these cohorts—together with the body of animal data—may assist in determining whether exposures to elevated levels of dioxins and related compounds are likely to have adverse health effects on human prenatal and postnatal development and what the quantitative relationship between exposure and effects might be, if any. The results to date are suggestive of incremental effects at each level above background, but do not conclusively implicate the dioxins and related congeners, in part because the exposures are mixed and in several studies are known to include heavy metals and pesticide residues (also potential neurotoxicants).

A number of studies have suggested that elevated environmental exposures to PCBs or a combination of PCBs, polychlorinated dibenzofurans (PCDFs), and polychlorinated dibenzo-*p*-dioxins (PCDDs) may cause developmental neurotoxicity in human infants (see Exhibit C-1). Some of these studies (e.g., Jacobson, Jacobson, and Humphrey 1990) were omitted from consideration in the draft dioxin reassessment document (EPA 1994), and some have been published since its release (e.g., Huisman et al. 1995; Lonky et al. 1996). An 11-year follow-up study on the Lake Michigan cohort of children found to have effects on visual memory as infants and effects on verbal and quantitative short-term memory at age 4 (Jacobson, Jacobson, and Humphrey 1990) shows that prenatal exposure to levels of PCBs slightly higher than those for the general population is associated with lower full-scale and verbal intelligence quotient scores after controlling for potentially confounding variables. The strongest effects were related to memory and attention. The Dutch study (Huisman et al. 1995) implicates PCDFs and PCDDs as well as PCBs. Gladen et al. (1988) observed a continuum of effect with increasing transplacental PCB exposure as did Jacobson, Jacobson, and Humphrey (1990). However, the changes seen at birth (Rogan et al. 1986) and in infancy by Gladen et al. (1988) did not persist further nor appear to have adverse effects on mental functioning. Because of the wide variety of chemical pollutants that were likely present in many of these studies including PCBs, mercury, hexachloro-benzene, 1,1-dichloro-2,2-*bis*-(p-chlorophenyl)ethylene (DDE, also known as p,p’-DDE), and mirex, none of the results show an association between any particular chemical and a specific behavioral effect. Several recent comprehensive reviews of the various studies on neurobehavioral effects following environmental exposures to PCBs suggest that due to methodological problems and the inconsistent and conflicting results, further research be undertaken to resolve the uncertainties concerning the risks of perinatal exposure to PCBs (Safe 1994; Schantz 1996).

Recent Dutch studies suggest changes in thyroid hormone status associated with human fetal and postnatal exposure to PCDFs and dioxins (Pluim et al. 1993; Sauer et al. 1994; Koopman-Esseboom et al. 1994; Weisglas-Kuperus et al. 1995). The effects reported in these studies are not in complete agreement for either the infants or mothers, possibly in part because the Pluim et al. (1993) study is for a far smaller group of mother-infant pairs than that of Sauer et al. (1994). The study by Koopman-Esseboom et al. (1994) on thyroid hormone concentrations showed a significant correlation between PCDD, PCDF, and PCB levels in human milk and lower plasma levels of thyroid hormones; however, all of the measurements were within the normal range. The clinical relevance of these small changes in thyroid hormone levels on the developing fetus and infant is unknown; additional research will be needed to determine its significance. However, disruption of thyroid hormone status is one possible route for TCDDs and related compounds to cause developmental neurotoxicity; and it will be important to see whether such observations can be replicated and clarified in future studies. Also, several of the studies suffer from potentially confounding mixed exposures (e.g., to heavy metals and pesticide residues in the diets of contaminated fish eaters). Thus, these studies, while suggestive, may not be conclusive for developmental neurotoxic effects of TCDD or dioxin-like exposures on human infants, particularly at ordinary background levels of exposure in the absence of other elevated toxins. The entire group of studies should be reviewed critically as a whole, together with the body of animal data, for their implications for human developmental toxicity. Such an in-depth review is beyond the scope of this report but ultimately this body of data may provide relevant information with regard to the issue of whether any additional exposure to dioxin-like substances causes adverse human health effects.

G.3.2 Cancer Risk from Dioxin-like Compounds—EPA Evaluations from 1985 to1995

From 1985 to 1995, EPA made three different assessments of carcinogenesis (EPA 1985, 1988, 1994) focused on TCDD—the 1994 reevaluation was followed by a detailed review by the EPA SAB, which differed from the 1994 draft document on a number of issues (SAB 1995). The 1994 reevaluation concentrated mostly on TCDD but used bioassay-based potency factors given as TCDD toxicity equivalent factors (TEFs) (Sect. E.3.3) which provided an operational basis for conversion of doses of congeners (referred to as dioxin-like compounds) to an ‘equivalent’ dose of TCDD referred to as TEQs. This summary is focused on aspects of those four efforts that might affect the understanding of the carcinogenic potential in humans over the past decade. The information in Exhibit G.2 suggests that fundamental ideas, data actually used, and conclusions have been very robust over time. The documentation has changed to accommodate new experiments and theory related to the role of the Ah receptor-cytochrome P450 linkage and its linkage with toxicity, but the conclusions are nearly the same. Similarly, the “unit risk” dosage associated with an extrapolated human risk of one-in-a-million per lifetime has tracked from 0.006 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$ (EPA 1985), through 0.1 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$ (EPA 1988), back to 0.01 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$ in EPA 1994. This should come as no major surprise considering that the Kociba et al. (1978) study conducted by Dow Chemical Company comprised data that were used to determine both the 1985 and 1988 estimates. The 1994 effort

Exhibit G.2. Summary of EPA evaluations of dioxin and dioxin-like compounds from 1985 to 1995

Mutagenicity and genotoxicity

EPA 1985:	Data on mutagenicity and genotoxicity are controversial and inconclusive. tetrachlorodibenzo-*p*-dioxin (TCDD) initiator in rodent cancers.
EPA 1988:	Some bioassays indicate metabolism may produce genotoxic intermediates; probably not genotoxic.
EPA 1994:	Probably non-direct initiating activity. Short-term assays may not respond to indirect effects of dioxin-like substances. Not generally considered genotoxic in traditional terms.
SAB 1995:	TCDD has no recognized capacity for initiation; it is not a complete carcinogen.

Animal carcinogenicity

EPA 1985:	Animal cancer data for oral exposure are adequate.
EPA 1988:	Animal cancer data for TCDDs are adequate.
EPA 1994:	TCDD is a multi-site carcinogen in animals.
SAB 1995:	Animal cancer data are unequivocal.

Metabolism and pharmacokentics

EPA 1985:	Metabolism and pharmacokinetic data are insufficient to permit modeling of equivalent human doses.
EPA 1988:	Provided an extensive review for use of a hormone-like mechanism.
EPA 1994:	Pharmacokinetic data were used to modify multi-stage coefficients.
SAB 1995:	EPA estimating 16 coefficients from 4 data points (p. 64).

Carcinogenic mechanisms

EPA 1985:	Mechanisms of action should be studied.
EPA 1988:	Controversy about carcinogenic mechanisms of TCDD.
EPA 1994:	Strong support for use of the Ah receptor as a direct index of effect and/or risk; potent modulators of cell growth and differentiation.
SAB 1995:	EPA overstated the case for Ah receptor mechanism—Ah is a marker of exposure but may be just an association. The significance of subtle biochemical and biological changes with TCDD exposure is unknown.

Dose-response model

EPA 1985:	Linearized-multistage model.
EPA 1988:	Qualified usage of the linearized-multistage model.
EPA 1994:	Evaluation is hybrid between curve-fitting and “pure mechanistic modeling” using physiologically based pharmacokinetic and two-stage models.
SAB 1995:	It appears that a threshold model would fit data equally well as the linear model.

Exhibit G.2. (Continued)

Animal cancer data used

EPA 1985:	Used female rats (combined sites) from Kociba et al. (1978) but average pathology from Kociba et al. (1978) and Squire (1980).
EPA 1988:	Used female rats (liver only) from Kociba et al. (1978), but pathology by Squire (1980).
EPA 1994:	Used female rats (liver only) from Kociba et al. (1978), but revised tumor incidence data based on Sauer (1990); used focal lesions from gavage study by Maronpot et al. (1993).
SAB 1995:	Although there was an abundance of animal data on TCDD, only one study (Maronpot et al. 1993) was added to the analysis.

Adequacy of epidemiological data

EPA 1985:	Epidemiological data are inadequate.
EPA 1988:	Epidemiological data are inadequate.
EPA 1994:	Limited epidemiological data were analyzed, but animal data were chosen for low-dose extrapolations.
SAB 1995:	Human data are limited and controversial; few chronic effects observed in humans. The EPA (1994) conclusion that dioxin and related compounds are likely to present a cancer hazard to humans at exposure levels within one or two orders of magnitude above background is not well-supported by the existing human epidemiologic data-base.

Human carcinogenicity

EPA 1985:	TCDD and hexachlorodibenzo-*p*-dioxin (HxCDD) are probable human carcinogens.
EPA 1988:	TCDD is a probable human carcinogen.
EPA 1994:	Dioxin-like compounds are probable human carcinogens.
SAB 1995:	Dioxin-like materials are probably carcinogenic to humans.

Characterization of TCDD

EPA 1985:	Cellular and biochemical data are inadequate for use in risk assessments.
EPA 1988:	Describing TCDD either as a promoter or a complete carcinogen is an oversimplification.
EPA 1994:	It appears that humans respond to polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) like test animals with biochemical and molecular similarities.
SAB 1995:	All evidence implicates TCDD as a carcinogenic promoter.

Development of scientific opinion on TCDD

EPA 1985:	TCDD was analyzed as a complete carcinogen.
EPA 1988:	Data on TCDD as a complete carcinogen, but data lacking on direct action.
EPA 1994:	TCDD is a potent, complete carcinogen in some experiments.
SAB 1995:	TCDD is not a complete carcinogen.

Exhibit G.2. (Continued)

Slope factor	
EPA 1985:	Slope factor is 156 $\mu g \cdot kg^{-1} \cdot d^{-1}$ for TCDD.
EPA 1988:	Slope factor is 10 $\mu g \cdot kg^{-1} \cdot d^{-1}$ for TCDD.
EPA 1994:	Slope factor is 100 $\mu g \cdot kg^{-1} \cdot d^{-1}$ for TCDD.
SAB 1995:	EPA must consider durability of conclusions—would other reasonable assumptions lead to different risks?
Other cogeners	
EPA 1985:	Slope is 6.2 $\mu g \cdot kg^{-1} \cdot d^{-1}$ for HxCDD.
EPA 1988:	Congeners not analyzed.
EPA 1994:	Used toxic equivalent (TEQ)/toxicity equivalent factors (TEF) models for more than 200 chemical congeners. No long-term animal cancer bioassays have been performed except for TCDD and HxCDD.
SAB 1995:	SAB supports concept but encourages more validation. It is not obvious how potencies were derived and how vigorously they can be defended.
Unit risk	
EPA 1985:	Unit risk dose for TCDD is 0.006 $pg \cdot kg^{-1} \cdot d^{-1}$.
EPA 1988:	Unit risk dose for TCDD is 0.1 $pg \cdot kg^{-1} \cdot d^{-1}$.
EPA 1994:	Unit risk dose for TCDD and TEQ-adjusted congeners is 0.01 $pg \cdot kg^{-1} \cdot d^{-1}$.
SAB 1995:	Unit risk is not supported by available data. EPA should have provided a more comprehensive analysis of human data.
Background exposure	
EPA 1985:	Concentration in foods, air, and water is unknown.
EPA 1988:	Upper bound daily intake estimated at 0.04 to 0.51 $pg \cdot kg^{-1} \cdot d^{-1}$.
EPA 1994:	From pharmacokinetic model, dietary intake estimates are: TCDD = 0.3 to 0.6 $pg \cdot kg^{-1} \cdot d^{-1}$; including dioxin-like PCDDs and PCDFs, TEQ = 1 to 3 $pg \cdot kg^{-1} \cdot d^{-1}$; with dioxin-like polychlorinated biphenyls (PCBs), TEQ = 3 to 6 $pg \cdot kg^{-1} \cdot d^{-1}$.
SAB 1995:	EPA tends to overstate danger. Uncertainties are not identified. Sensitivity analyses needed to estimate solidness of conclusions. Estimates of average exposure are reasonable but have substantial uncertainties—need population distribution data.

added an updated evaluation by Sauer et al. (1990) of the animal tumor data from the Kociba et al. (1978) study and a short-term study by Maronpot et al. (1993). The SAB offered strong criticism that more usage was not made of the much greater abundance of animal data and of the data base on human carcinogenesis associated with exposures to dioxin-like compounds.

As described by Silbergeld (1995), risk assessments for dioxins have been done around the world. Each estimate has defined an acceptable level of increased cancer risk as one in a million, and all use the same rat data, yet they differ by orders of magnitude in terms of the exposure associated with that risk. The differences arise from the models used to fill in between high-dose animal data and most measured or anticipated human exposures. This variability results in acceptable daily intakes that range from the EPA value of 0.006 to 10 $pg \cdot kg^{-1} \cdot d^{-1}$, which has been recommended by the World Health Organization and is used in some European countries (BSM 1992). The following list provides a profile of the carcinogenic properties of TCDD as described in the 1985, 1989, and 1994 EPA evaluations and the 1995 SAB review:

1. *Mutation of cells and genotoxicity*

TCDD seems to induce cancer in animal experiments (see Exhibit B-2), but mutagenic and genotoxic effects are not registered in short-term tests. Thus, in the classical sense, TCDD cannot be considered a complete carcinogen. This issue continues to be a dilemma and carries forward into whether TCDD is a complete multisite carcinogen or simply a promoter of carcinogenesis whose effects are reversible upon termination of exposure.

2. *Animal carcinogenesis*

Considered to be adequate in all evaluations for TCDD and a mixture of two isomers of hexachlorodibenzodioxin; no other PCDDs or PCDFs have been tested for carcinogenicity.

.

3. *Metabolism and pharmacokinetic models*

Models and data have improved but cannot provide any practical improvements in risk assessment models.

4. *Mechanisms of carcinogenic action*

From an assessment perspective, there has been no significant change The 1994 reevaluation provided strong assertion for an Ah receptor mediated mechanism of action, but members of SAB noted that the behavior may be simply an association (biomarker of exposure not of deterministic significance) or measure of a cell's attempt to protect itself and that toxicity events may actually be in a different pathway. Although much is known regarding the Ah receptor and cytochrome P450 linkage, it is highly speculative to link Ah receptor events directly to the mechanisms of carcinogenic action.

5. *Dose-response model*

All EPA cancer risk assessment evaluations used low-dose linearity either from the multistage model or its condensation to a two-stage formulation. However, the SAB criticized the EPA's 1994 draft dioxin reassessment for failing to consider a benchmark or threshold model instead of simply adopting a linear approach.

6. *Animal cancer data used for model evaluation*

The Dow Chemical study has been used constantly throughout the decade, except that individual variations in pathology as reported by Kociba et al. (1978), Squire (1980), and Sauer (1990) have been factors of uncertainty. Additional variation results from choice of pathological site (e.g., whether effects are for combined pathological sites or restricted to certain neoplasms of the liver). The 1994 analysis added one experiment (Maronpot et al. 1993) to the analysis of the Kociba et al. (1978) experiment so that two experiments have now been chosen from many available cancer experiments on several species. As implied, there is a wealth of animal carcinogenesis data that have never been used in the derivation of guidance criteria, for example the male rat data from the Dow study by Kociba et al. (1978).

7. *Interspecies differences*

The SAB noted that interspecies difference in animal studies, range over a factor of 10,000. No single animal model can accurately predict human responses. Based on available data, it is debatable whether the most sensitive species, or the most representative animal species should be used when selecting an animal model to predict TCDD toxicity in humans.

8. *Risk coefficients (i.e., slope factors) and unit risk*

Risk coefficients are used in the sense of "*risk* = *slope* × *dose*" and therefore unit-risk factors and slope factors are inversely related. The 1985 values and the 1994 values are similar within a factor-of-ten; they reflect a less serious hazard than was perceived in 1988—all values are well within the bounds of uncertainty and assumption. The SAB recommended strongly that such sensitivity evaluations be considered, but it is almost certain that the range will span from zero to a very large risk. Also the SAB noted that EPA's preferred dose response model is linear, but "it seems clear that a threshold model would provide an equivalent or nearly equivalent description of the data. This is the most important issue in the dose-response-modeling…"

9. *Background exposure and risk*

In the 1994 reanalysis of the health risk from TCDD and dioxin-like compounds, the EPA has considered PCDD, PCDF, and PCB congeners, with chlorine substitutions in at least the 2, 3, 7, and 8 positions, all converted to isotoxic dose equivalents of TCDD—the best-studied member. One of the most confusing issues arising from the EPA reanalysis is that of choosing a value prudent for protection versus the need for a realistic prediction of risk in human populations hypothetically exposed to a particular dosage. By traditional EPA methods, the two goals have not been distinguished adequately in many cases.

Generally, carcinogenic substances have been analyzed in terms of both their carcinogenic potency and their potential to cause non-carcinogenic but adverse effects according to methods used in classical toxicology. The processes usually include a comparison of the risk specific dose (RSD) (selected on the basis of a risk level of one in a million for some compounds and one in a hundred thousand for others) with a RfD based on a NOAEL, LOAEL, low observed effects level (LOEL), or no observed effects levels (NOEL), modified by a very large safety factor. The most limiting value for either the RSD or the RfD is usually taken for hazard control.

When a slope factor, unit risk dose, or RSD for cancer has been derived from animal data, the intent has been to estimate the 95% upper bound on low-dose risk, and sometimes the RSD was set on a risk of 10^{-5}. In contrast, if the slopes or unit risk doses were based on epidemiological data, the goal was to estimate the most probable values instead of the upper 95% limit and the RSD was often set for a risk of 10^{-6}.

The RfD is based on an experimentally determined estimate of a NOAEL, LOAEL, LOEL, or NOEL [chosen according to availability and relevance] reduced by a composite safety factor. In many of EPA's applications, additional confusion has resulted from the interchangeable use of "safety factors" and "uncertainty factors," and some publications have attempted to demonstrate equivalence of particular interpretation of the two distinct ideas (Dourson and Stara 1983, Dourson et al. 1985). But with the additional confusion regarding the RfD concept for TEF/TEQ models being used to estimate risks associated with normal human background exposure levels and to infer risk increases associated with incremental exposures above normal background for dioxin-like compounds, it is important to remember that statistical uncertainty factors are quite different from the EPA's safety factors and the two should not be equated either in concept or in magnitude.

"Safety factors" as used by the EPA, were devised to estimate a "safe" dose to a hypothetical sensitive human subpopulation when fragmentary data on humans or animals are available. Some chemicals have had very limited testing; other chemicals have been tested more exhaustively. Safety factors help accommodate this situation. For any particular compound, the "permissible exposure" may be safe by a wide but unknown margin, perhaps many orders of magnitude. A disadvantage in this absolute decision-making schema is the inconvenience and expense of usually large, but unknown, margins for safety and the complete lack of correspondence of the RfD concept from compound to compound. Thus, relative comparisons are not relevant. Safety and/or modifying factors that have been used in deriving RFDs include:

- intra-species variability (a factor of 10);
- inter-species variability (a factor of 10);
- subchronic test data when chronic not available (a factor of 10);
- using LOAEL when NOAEL not available (a factor assigned ranging from 1 to 10);
- test data do not reflect the rout of exposure for humans (a factor of 10);
- use of acute test data when chronic data not available (a factor of 10), and
- qualitative professional judgements regarding scientific uncertainties not covered under the standard safety factors, such as the completeness of the data base for a particular chemical and the number of animals in the key study—these considerations are described as a "modifying factor" (a factor of 1 to 10).

Traditionally, EPA has used the first four factors to establish composite safety factors of 10, 100, 1,000, or 5,000 for RfD considerations; however, the last modifying factor may be used to decrease the RfD by up to another order of magnitude.

Although a "possibly safe" dose decreased by additional factors ranging from 10 to 100,000 could, at least in theory, produce a "more safe" dose [assuming that risk is some value greater than zero], it appears that values so derived may distort the reality between protection and risk. Such distortion impedes accurate ranking of chemicals, site/technology prioritization or selection, and a host of other considerations that depend upon reasonably accurate relative comparisons. With respect to the current situation of producing low, or perhaps even trivial, concentrations of dioxin-like compounds during the incineration of chemical warfare agent, the

RfD concept seems to imply a risk increment that is unlikely to be detected in any sensitive bioassay or study of sensitive human biomarkers of exposure or risk.

G.3.3 Toxicity Equivalents and Toxicity Equivalent Factors

Dioxins are used to refer to the family of structurally similar compounds comprising TCDD and other 2,3,7,8-substituted dioxins, 2,3,7,8-substituted furans, and those PCB congeners with at least four chlorine atoms which can assume a planar configuration and have dioxin-like activity, including the non ortho, mono ortho, and a few di ortho PCB congeners. EPA (62 FR 24887) provides descriptions of these compounds, their properties, and the common processes that produce them.

The TEF procedure rests empirically upon the ability of TCDD and its various congeners to induce enzyme production via the Ah receptor (Birnbaum and DeVito 1995). Since TCDD is the most potent congener, the TEFs derived for all other congeners are primarily an expression of their ability to induce P-450 enzymes via binding to the Ah receptor relative to TCDD. The TEQ methodology assigns TCDD a TEF value of 1 and all other congeners are assigned TEF values of 0.001 to 0.5 depending on their potency relative to TCDD. Enzyme production is itself not toxic, but is used as a "biological marker" for possible toxic effects. Any connection between this enzyme induction and possible toxic effects has not yet been shown.

The principal identified sources of PCDDs and PCDFs are combustion and incineration of chlorine containing fuels, chemical manufacturing/processing sources as by-products, industrial and municipal processes, such as those involving wood pulp (manufactured using chlorine as a bleaching agent) and reservoir sources which may result in exposures produced by redistribution of material.

The TEF procedure used in the EPA's dioxin reassessment was developed under auspices of the North Atlantic Treaty Organization's Committee on Challenges of Modern Society to promote international consistency in addressing contamination involving PCDDs and PCDFs. With this TEF methodology, PCDDs and PCDFs with chlorine substituted in the 2,3,7,8 positions are assigned nonzero values (Table G.1). Additionally, the analogous brominated compounds and certain PCBs have been identified as having dioxin-like toxicity and are also included in the definition of dioxin-like compounds. However, EPA has not assigned TEF values for brominated dibenzo-*p*-dioxins, brominated dibenzofurans, and PCBs.

Table G.1. Toxicity equivalent factors (TEF) for polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans

Congener	TEF	Congener	TEF
Tetrachlorodibenzo-*p*-dioxin (TCDD)	1	Tetrachlorodibenzofuran (TCDF)	0.1
Pentachlorodibenzo-*p*-dioxin (PeCDD)	0.5	Pentachlorodibenzofuran (PeCDF)	0.5
Hexachlorodibenzo-*p*-dioxin (HxCDD)	0.1	Hexachlorodibenzofuran (HxCDF)	0.1
Heptachlorodibenzo-*p*-dioxin (HpCDD)	0.01	Heptachlorodibenzofuran (HpCDF)	0.01
Octachlorodibenzo-*p*-dioxin (OCDD)	0.001	Octachlorodibenzofuran (OCDF)	0.001

The procedure relates the toxicity of structurally related PCDD and PCDF congeners and is based on a limited amount of *in vivo* and *in vitro* toxicity testing. In application, the methodology steps include

1. Analytical determination of PCDDs and PCDFs in the sample.
2. Multiplication of congener concentrations in the sample by the TEF for each congener to express the concentration in terms of TCDD equivalents.
3. Summation of the products in Step 2 to obtain the total TEQs in the sample.

The SAB (1995) has reviewed the use of TEFs and TEQs and noted that TEFs are used to address the broad range of dioxin-like compounds having the common property of binding to the Ah receptor and producing related responses in cells and whole animals: "The use of the TEFs as a basis for developing an overall index of public health risk is clearly justifiable, but its practical application depends on the reliability of the TEFs and the availability of representative and reliable exposure data." Since only about 10% of the total exposure to dioxins is likely to be from TCDD, if TEFs are going to be used, it is obligatory to have good information on distribution, metabolism, and half-lives of other major components.

Since the EPA 1994 analysis, the carcinogenic potential of dioxin-like compounds has raised significant concern—because the slope factors (or unit risk factors) have changed little over the 1985–94 interval. Similarly, the personal "background" dose, although unknown in 1985, was estimated in 1988 and is still quite consistent with estimates proposed in 1994 for TCDD. What has changed is the use of TEQ and TEF models that combine over 200 congeners into a single toxicity index keyed to TCDD. The use of 50% of detection limit for all non-detected congeners ensures that "background" will be an upper bound. This upper bound of exposure is then mated to the dose response model, which itself has a variation of 1,000 fold from country to country. Moreover, another upper limit assumption is added but often overlooked…that hyperplastic foci in rat liver are equivalent to a fatal hepato-carcinoma in humans. Even with this abbreviated discussion, it can be seen that what is presented by EPA as an upper bound is, in effect, a product of multiple upper bound models and assumptions. Hence, it should be expected that highly inflated models of risk and highly inflated models of background body burdens predict small, if any, margins for safety with respect to cancer, or other health effects.

G.4 AMBIENT BACKGROUND

Dioxins are produced in very small quantities (never intentionally in an industrial setting). In 1987 the EPA estimated the cumulative annual releases from known sources to be about 12 kg/year (25 lb/year) in the United States; more recent EPA estimates suggest the present value is about 3 kg/year (EPA 1998). Combustion and incineration sources of dioxins include municipal waste, sewage, medical wastes, metallurgical processes, and burning of coal, wood, petroleum, and used tires. Major contributions to total annual production include medical and municipal incinerators, secondary copper smelters, forest fires, and cement kilns which burn hazardous waste. Motor vehicles, hazardous waste incinerators, industrial wood burning, and other metal smelting are more moderate contributors of dioxin-like compounds, followed by activities involving incineration of sewage waste, and residential wood burning (see EPA 1994, Vol. I, Table II-2, pp. 17–18 for a table of the major emission sources and their airborne emissions in grams of TEQ TCDD per year.) Deposition measurements in Europe and in the United States suggest deposition rates of about 1 ng TEQ$\cdot$m$^{-2}\cdot$year^{-1} are typical for remote areas and 2 to 6 ng TEQ$\cdot$m$^{-2}\cdot$year^{-1} for populated areas.

Methods and limitations regarding the EPA (1994) exposure assessment for dioxin-like compounds (as described by the SAB) are given in Exhibit G.3. A brief synopsis of exposure as portrayed in the 1988 EPA document is found in Exhibit G.4.

The EPA (1994) stressed that the margin of safety (between background exposures and levels of exposure where effects have been observed in test animals) for dioxin-like compounds is smaller than that which EPA usually accepts for many other compounds. As described in Sect. E.3.3, the new EPA approach, based on TEQ/TEF models and combining the effects of many congeners in a single toxic index seems to be a point of concern when such considerations are further inflated by assumptions regarding upper bounds on dose response models, pathologic equivalences between nodules and cancers and the treatment of concentrations below limits of detection as if they were present at 50% of the detection limit.

The SAB was very concerned that a distinction be made between ordinary background and the high-end levels observed in the studies cited: "There is an inference that humans are at risk from background and near-background exposures. The term background, because of its implications in ordinary discourse, needs to be amplified in the context of the dioxin reassessment. Background typically refers to exposure levels that are not out of the ordinary experience. The populations described by Jacobson et al. (1990b), Gladen et al. (1988), and Huisman et al. (1995), which demonstrate associations between PCB (and in the Huisman study, PCBs and dioxins) exposure and neuro-developmental deficits, would be classified at the high end of the background distribution. This distinction needs to made clear by EPA."

G.5 INCINERATION AS A MAJOR SOURCE OF DIOXINS

G.5.1 Development of the Science

The question of whether or not incineration is a major source of dioxin dates back to the late 1970s. At that time public and federal agencies concerns about emissions of PCDDs and PCDFs intensified when these compounds were discovered at both municipal and hazardous waste incineration facilities (Travis and Cook 1989, p. 102). Incineration as an important source of these two classes of compounds was generally acknowledged by the early 1980s (EPA 1994 p. 3-64; Brunner 1985, p. 63). In testing a variety of industrial stationary combustion sources during the National Dioxin Study in 1987, the EPA made a series of qualitative observations on the relationship between total chlorine present in the fuel/waste and the magnitude of emissions of PCDDs and PCDFs from the stack of tested facilities (EPA 1987 as reported in EPA 1994, p. 3-72). In general, combustion units with the highest PCDD emission concentrations had greater quantities of chlorine in the fuel/waste, and conversely, sites with the lowest PCDD emission concentrations contained only trace quantities of chlorine in the feed.

Exhibit G.3. Methods and limitations regarding the EPA 1994 exposure assessment for dioxin-like compounds (EPA 1994; SAB 1995)

- Uncertainties include detection-point contributions from local versus distant sources: Fraction of exposure cannot be simply associated with fractions of emission.
- Considerable uncertainty exists regarding the accuracy of toxicity equivalent factor (TEF)/toxic equivalent (TEQ) models.
- A background was estimated from the human diet by using 50% of the detection limit for non-detected congeners and central estimates for consumption. TEQ = 119 pg/d of tetrachlorinated dibenzo-*p*-dioxin (TCDD) equivalent, 90% of which is expected from the diet.
- Body-burden data and pharmacokinetic models estimate from 10 to 30 pg/d for TCDD, which is consistent with the preceding value for the TEQ of dioxin-like congeners.
- The EPA estimate for the average is reasonable, but a population distribution is needed.
- EPA describes "background" for sites removed from known contamination (based on general food supply) and expresses concern that "comparison of estimated exposures from a single planned facility to this 'background' might not be adequate if the region already had a higher level of exposure than the 'background' due to the presence of multiple existing sources."
- A site-specific assessment addresses the incremental exposure from a specific source.
- To estimate a "baseline" exposure, (1) default values should be replaced with site-specific data, (2) data from a comparable site should be used if site-specific data are unavailable, and (3) and regional data should be used if comparable site data are unavailable. Use of national background data may be inappropriate for specific sites.
- Because TEQ/TEF models indicate that 10–100 times background poses a risk, more realistic treatments of the congeners that consider "agonist and antagonistic" effects should be attempted.
- EPA: Cancer and other adverse effects may not be detectable until exposure exceeds background by factors of 10 to 100.
- Margins between background and levels that cause detectable effects in humans are considerably smaller than previously estimated.
- Data on subsistence fishermen indicate EPA's estimated body burdens may be 100-fold high.

Exhibit G.4. U.S. Environmental Protection Agency comments available in 1988 from report EPA (1988), EPA/600/6-88/005A[a]

- Sources considered for human exposures included soil, land disposal, and municipal waste incineration.
- The Centers for Disease Control and Prevention raised concerns if concentrations in soil are above 1 ppb in residential areas.
- Human exposures are likely to result from foods, ingestion or contact with soil, and inhalation of dust and vapors.
- Pathway analysis, bioavailability, absorption, consumption, and bioaccumulation were included. Plant uptake and pharmacokinetics were discussed.
- Scenario-dependent numbers are not applicable to specific sites.
- Highest exposures result from the food chain.
- Reasonable worst case scenarios indicate that tetrachlorinated dibenzo-*p*-dioxin (TCDD) at 1 ppb could cause risk of 10^{-2}; however, careful handling can reduce risk to 10^{-8}. At 1 ppt, risk was about 10^{-5}.
- Pharmacokinetics were used to calculate (from body burden data) an estimate for the upper limit “background” daily intake in the United States.
- Upper limit daily intake ranged from 0.04 to 0.51 $pg \cdot kg^{-1} \cdot d^{-1}$.

[a] EPA (1985) states that concentrations of TCDD in foods, air, and water are unknown. In 1994, the third EPA reassessment of TCDD describes estimates of human exposures to TCDD at 0.3–0.6 $pg \cdot kg^{-1} \cdot d^{-1}$, based on pharmacokinetic modeling and dietary considerations. Pharmacokinetic modeling has not been applied to other polychlorinated dibenzo-*p*-dioxins (PCDDs) or polychlorinated dibenzofurans (PCDFs); background toxic equivalent (TEQ) exposures to these materials have been estimated to be 1–3 $pg \cdot kg^{-1} \cdot d^{-1}$. Adding dioxin-like polychlorinated biphenyls (PCBs) raises background TEQ exposure to 3–6 $pg \cdot kg^{-1} \cdot d^{-1}$, assuming that diet comprised about 90% of the typical exposure.

At the time of preparation of the CSDP FPEIS in 1986–87, the question of considering inclusion of dioxins and furans as possible combustion products and an analysis of their potential health effects was considered. However, they had not been identified as combustion products of the warfare agents (U.S. Army 1988, pp. B-16,17). Data from agent combustion trials indicated that the design of the incinerators provided sufficiently high temperatures and long residence times such that dioxins and furans were not formed at measurable levels (U.S. Army 1988, pp. B-119–121). The only other source contributing chlorinated molecules would be the dunnage (packing materials including wood and possibly some plastic). Assessment of emissions or health effects from this source was outside the charge to the assessment team.

Since the publication of the original FPEIS (U.S. Army 1988), a measurement program has been carried out on the prototype chemical agent incinerator at JACADS. These measurements supported health risk assessments conducted by the U.S. Army on the incineration of chemical agents during the operational verification testing at JACADS (AEHA 1992). Emissions of dioxins and furans were included in the health risk assessments. However, only extremely small quantities of dioxins and furans were emitted from the JACADS incinerators. The JACADS air emission standard for dioxins and furans was 30 ng/dscm (dry standard cubic meter) total dioxins/furans, based on emission limits from large municipal waste combustors built after December 20, 1989 (Appendix A, Table A.5). The measured TEQ emissions of dioxins and furans from the various incinerators and furnaces at JACADS ranged from 0 to

1.48 ng/m^3 (see Appendix A, Table A.7); this is in the parts-per-trillion range. No TCDD was detected.

The results of the Army's health risk assessment (Appendix A, Table A.8), show that the total cancer risk, the total chronic non-cancer risk, and the total acute non-cancer risk resulting from exposure to air emissions from incineration of the three agents (i.e., GB, VX, and mustard) at JACADS are all less than the EPA-established levels of concern for the general public. In these risk assessments, agents GB, VX, HD, dioxins, and furans were assumed to be present at concentrations equal to one-half of their analytical detection limit, even when the concentration was otherwise undetectable. For carcinogenic chemicals, the concern was for the risk of an individual contracting cancer by being exposed to ambient concentrations of that chemical over the course of a lifetime. The assessment methodology used by the Army was very conservative and protective of human health. These health risk assessment results also indicated a large margin of safety above the acceptance criteria from all three measures of health (cancer, chronic non-cancer, and acute non-cancer).

At the time of preparation of the FPEIS, the understanding with respect to products of incomplete combustion was that "Under the conditions of temperature and residence time proposed for incinerator operation, no chlorinated hydrocarbon releases are expected" (U.S. Army 1988, p. B-157). This perception was supported by the earlier studies on emissions from incineration system tests performed during the 1980s at Tooele Army Depot (now Deseret Chemical Depot) in Utah. The Chemical Agent Munitions Disposal System (CAMDS) at Tooele was developed to test and evaluate equipment and processes to be used in chemical agent/ munitions destruction plants. Three furnaces were built and tested at CAMDS: a deactivation furnace system, a metal parts furnace, and a liquid incinerator. These furnaces were used to provide the basis for design of the JACADS, which has been used as a testing/demonstration facility for the next generation of chemical agent incinerator systems. Each of the three furnaces underwent a series of tests and evaluations. The last of these tests prior to completing the FPEIS was run in May 1986 to identify products of incomplete combustion of GB agent. "No PICs [particles of incomplete combustion], in terms of RCRA [Resource Conservation and Recovery Act]-specified compounds, were detected in the exhaust gases…" (U.S. Army 1988, p. D-16). Emission standards at that time included the chemical agent, hydrogen chloride, particulates, sulfur dioxide, and opacity. Thus, given the standards at the time and the very high temperatures achieved, little to no attention is visible with respect to the possible production of complex ring structures like TCDD.

The first mention of TCDD and agent incineration identified comes from the report of the first testing of the JACADS. In fulfillment of the operations verification tests requirements, three trial burns were performed in the liquid incinerator on December 5 and 6, 1990, with liquid agent GB as the feed material. These trial burns were conducted to demonstrate compliance with the RCRA during the destruction of GB. In addition to monitoring for RCRA materials, nonregulated materials were also monitored. Dioxins and furans were found in the stack emissions during the trial burns at levels approaching the detection limits, with a range of 0.02 to 0.16 ng/m^3 (SRI 1991). It is also recorded (SRI 1991, p. 12) that "conversations with EPA personnel involved in the assessment of incinerators relative to dioxin/furan emissions suggest that a level of 10 ng/m^3 should not cause concern." [At that time, previous studies of municipal incinerators demonstrated emissions of dioxins in the 50- to 7000-ng/m^3 range.] Additional tests at JACADS have revealed small amounts of dioxins and furans for other agents and incinerators.

G.5.2 Conclusions

Trial burns in the several incineration systems at JACADS with agents containing chlorine resulted in very low levels of dioxins and furans when they were detected. Often, these chemicals were not detected. Trial burns with the non-chlorinated agents sometimes resulted in the detection of low concentrations of PCDDs and PCDFs. The origin of chlorine which must enter into reactions when burning non-chlorinated agents in order to form the dioxins measured was not discussed in any of the literature reviewed except for the possible contamination in fuel oil or process water (SRI 1991). Because JACADS is located on a small island in the Pacific Ocean, there will be significantly more chlorine in the ambient air there than at other stockpile locations. Tests of the deactivation furnace system burning materials containing some PCBs resulted in the finding of small quantities of dioxins. These finding were expected because some of the materials burned contained PCBs, known precursors of dioxins. Overall, the concentrations of PCDDs and PCDFs measured at the JACADS facility are small with respect to regulations for hazardous waste incinerators (see Appendix A, Table A.3), as well as unregulated sources. Dioxin production at hazardous waste incinerators was well known at the time of the preparation of the FPEIS and might have been suspected in trace quantities in agent incineration. However, given the low availability of chlorine atoms in the agents, the general lack of precursor molecules, the high design temperatures and long resident times, and the lack of identification during the CAMDS incineration tests, it is not unreasonable that attention was not given to dioxins in the FPEIS.

G.6 COMPARISON OF JACADS DIOXIN EMISSIONS WITH UNREGULATED AND REGULATED SOURCES

Information about the importance of a new or poorly understood topic can often best be understood when it is presented in the form of relative comparisons and when the standards for comparison are universally recognized. At the time of the development of the FPEIS, there was a general recognition that incinerators could be sources of dioxins. Other, less obvious sources of dioxin are also now recognized within the scientific community. Because of the general familiarity with motor vehicles, cigarettes, wood burning fireplaces and hazardous waste incinerators, their emissions will be compared with those from the JACADS incinerator.

Rogers (1995) analyzed the mass emission rate from the deactivation furnace system at JACADS during the test burns which served the dual purpose of a Toxic Substances Control Act demonstration burn and a RCRA trial burn (AEHA 1992). Emissions from this incinerator are representative of the JACADS incinerators. Rogers (1995) derived a TEQ for average emissions as 22 pg/s. Based on EPAs latest estimates for vehicle emission, a diesel truck traveling at an average speed of 64 km/hr (40 mph) would emit approximately 3 pg/s TEQ. Thus the average emissions from the JACADS incinerator trial burns are about equivalent to 7 trucks.

Data for gasoline powered motor vehicles is only slightly more abundant than for diesel-fueled vehicles. The review presented in EPA (1994) attempted to derive estimates of TEQ for leaded and unleaded fuels. Generally, the leaded fuels had similar or higher TEQs than the diesel, and the unleaded fuels had lower values. However, the gasoline data generally fall within plus or minus an order of magnitude of the diesel figure. From these figures, the

JACADS incinerator would be difficult to distinguish from at most a few motor vehicles as a source for TCDD/TCDF.

A second point of reference for human exposure to dioxin is the cigarette. Cigarette smoking is thought to be a secondary source of exposure to dioxins with dietary sources being the predominate pathway (Muto and Takizawa 1992). Total dioxin equivalent TEQ of cigarette smoke has been measured by several researchers; see, for example, the work of Löfroth and Zebühr (1992) and of Muto and Takizawa (1989). One article (Löfroth and Zebühr 1992) found the TEQ of sidestream smoke to be about a factor of two above that of mainstream smoke. While TEQs have considerable variation, Matsueda et al 1994 found the average of seven U.S. brands to be 8.6 pg/pack. A comparison can now be made with the average emission of 22 pg/s for the TEQ of a JACADS incinerator, as estimated by Rogers (1995). An equivalent rate of dioxin release from cigarettes would be the burning of 2.5 packs per second.

Residential wood burning provides another source for comparing dioxin production. Data presented in the EPA study of exposure to dioxin-like compounds (EPA 1998) leads to an average dioxin production rate of 2 ng/kg TEQ. Thus, the burning of an average kilogram of wood in a residential setting produces the equivalent of about 2 ng of dioxin. If the typical wood heating fire consumed about 10 kg (22 lb) of wood per hour, the fireplace (or woodstove) would be emitting about 5.5 pg/s. This is about four times less than the average emission rate of the JACADS incinerator as estimated by Rogers (1995).

The last comparison to be made is for a regulated source, hazardous waste incinerators and the primary source of TEQ data is the EPA’s exposure source document (EPA 1998). Again, the emission rate in grams per second released from these sources is highly variable. The average release rate of dioxin equivalent estimated by the EPA is 1.1 ng/s which is roughly 50 times greater than the average emission rate estimated for the JACADS incinerator.

G.7 CONCLUSIONS

- Data published later than the 1988 FPEIS (U.S. Army 1988) suggest that the estimate for a non-cancer NOAEL may need to be lowered, at least by an order of magnitude or more, but to date neither EPA (1994) nor the SAB (SAB 1995) have recommended a new value.
- The EPA draft dioxin reassessment report (EPA 1994) appeared to identify several new effects of dioxin in humans from epidemiological studies including (1) changes in male reproductive hormones, (2) a slightly increased risk of diabetes, and (3) an increased level of the liver enzyme GGT in blood. However, these are not considered to be conclusively established. Furthermore, there is no clear indication that elevated GGT activity by itself without other enzymes normally released in liver disease is an indicator of adverse clinical health effects.
- Immunotoxic effects in humans have not been convincingly documented as a result of TCDD/TEQ exposure.
- The statements in EPA (1994) regarding there being a smaller margin of exposure than previously thought, or the implication that adverse effects on human health are occurring at or near background levels, are judged by the SAB (1995) not to have been convincingly demonstrated in the EPA draft dioxin reassessment report (EPA 1994).
- On-going studies on developmental neurotoxicity (effects on mental function and neuromotor development from *in utero* exposure) in humans (from studies on four groups

of infants with mixed environmental exposures to elevated levels of dioxins and related compounds) may help in determining whether such exposures are likely to have persisting adverse health effects. They may also shed light on what the quantitative relationship between exposure and effects is, if any. However, these studies are subject to confounding factors including exposure to other, potentially neuorotoxic compounds not related to dioxins, which undermine their ability to relate TCDD and the effect(s) being studied.

- The animal evidence and studies of human developmental neurotoxicity together warrant a reexamination by EPA of NOAELs and establishment of benchmark doses and a reassessment of public policy. However, adequate information is not now readily available in the published literature on which to base a revised health assessment of the potential non-cancer health consequences of the anticipated very low emissions of TCDD and other dioxin-like compounds from individual incinerator complexes constructed as part of the CSDP.
- EPA (1994) estimated that if the usual procedures were followed to set a RfD for TCDD, it would be about 10^{-5} μg/d (10 pg/d) or about 10–100 times below the estimated daily intake of dioxin-like compounds. However, both EPA (1994) and SAB (1995) reject the use of an RfD because TCDD/TEQs are not like the substances for which RfDs have been used. Rather, these substances accumulate in the body and it remains to be determined if background levels are high enough that they need to be taken into account in evaluating the impact of incremental exposures associated with a specific source.
- Biochemical and molecular mechanisms of toxicity and carcinogenesis are still insufficiently understood and cannot be used as an index of harm at low-doses.
- As low-dose linearity has been merely assumed, the SAB requested that threshold or benchmark models for cancer be considered; that is, in light of the weight of the evidence, is there a dose level too low to cause cancer?
- Human cancer data are inconclusive and most cancer risk estimates for TCDD are based on the Dow Chemical study of Kociba et al. (1978) with the organ effects data classified independently, and somewhat differently, by three different pathologists; additional imprecision results from choice of the mathematical model used to fit the experimental data as interpreted by the pathologists. A study of U.S. chemical workers found elevated cancer risk only for the most highly exposed workers over long periods of time; even this study was confounded by such alternate causes as smoking and exposure to other potentially carcinogenic chemicals. In reviewing this study the SAB noted, “Given the possible confounding, and the somewhat equivocal links of dioxin to excess cancer in the group as a whole, it is difficult to document a dioxin-cancer relationship.
- Based on animal data TCDD is still considered to be a probable human carcinogen even after exhaustive studies of humans that were highly exposed have failed to provide adequate positive evidence for unambiguous interpretation. While animal data are unambiguous, some human data suggest TCDD is not carcinogenic and even anticarcinogenic at some exposure levels. However, biomarkers of exposure and response seem similar between animals and humans. [A workgroup of the International Agency for Research on Cancer, has concluded that TCDD should be considered a “known human carcinogen,” but this workgroup decision does not provide a regulatory basis (RPR 1997).]
- The unit risk concept of one death in a million persons exposed for a lifetime was associated with a dose of TCDD of 0.006 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$ when the FPEIS was prepared and was revised to 0.01 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$ in 1994 (no change of significance).

- The human background or body burden dose was not estimated in 1985 but the range of 0.04 to 0.51, published in 1988, is similar to the EPA 1994 range of 0.3 to 0.6 $pg \cdot kg^{-1} \cdot d^{-1}$ for TCDD.
- Consideration of other PCDD and PCDF congeners and dioxin-like PCBs may increase the TEQ (the toxic effect equivalents of TCDD) up to a factor of 10.
- Background exposures to TCDD and the evaluations of cancer risk for TCDD are sensibly unchanged over the past decade. The perceived change is that many other chemicals (comprised of dioxins and furans) are structurally similar to TCDD with respect to the positions of chlorine atoms on the molecule and are summed together using the TEF/TEQ methodology to add to the toxicity of TCDD. Although the molecular and biochemical processes are largely unknown, and are subject to continuing debate, the additive effect model is based on the respective congeners' ability to bind to the Ah receptors of a cell. However, the SAB recommended that the assumption of additivity be more throughly documented by the EPA.
- This arbitrary grouping of a class of compounds, summing their potencies based on affinity for the Ah receptors, and assuming that each of these compounds is always present in a concentration that is at least 50% of the detection limit leads to concerns about risk (if the EPA applied similar models to other chemical classes, it is likely that similar concern would develop for classes of metals, organic solvents, organophosphates, etc.).
- Estimates of exposure are upper-bound in nature, and, in addition, risk coefficients have several factors of upper-bound uncertainty. In conclusion, these compounded and often unrealistic assumptions cause the TEF/TEQ model to indicate concern in situations where risk control practices seemed consistent with EPA intent (51 FR 33992) before the new models and their attendant assumptions were disseminated.
- Large uncertainties exist in estimates of exposure, dose, background, and hazard or risk.
- The general knowledge of hazardous waste incinerators as a source of dioxins has changed little since the early 1980s. However, given the JACADS high temperature design, the low availability or absence of chlorine atoms in most of the warfare agents, and the lack of previous detection of dioxins in the early incinerators at Tooele, dioxin production was not anticipated at JACADS during the design phase. Trial burns at JACADS since 1989 have verified that very small quantities of dioxins are produced.
- Dioxin emissions from JACADS can be compared with a number of familiar combustion sources. The JACADS TEQ emission rate, based on the trial burns conducted to demonstrate compliance with the RCRA for one of the incinerators is estimated to be approximately 22 pg TEQ per second. This average emission rate is roughly equivalent to the operation of seven diesel trucks traveling at approximately 40 mph. A similar comparison can be made of the dioxin content of cigarette smoke. The total smoke from a pack of cigarettes is found to yield about 8.6 pg TEQ. Thus, JACADS may release the equivalent dioxin of about 2.5 packs of cigarettes per second. However, while cigarette smokers are exposed to most of the total amount of TEQ, JACADS emissions or those from other agent destruction incinerators will be greatly diffused before impacting upon receptors. Residential wood burning also provides a basis for comparison. A fireplace burning 10 kg (22 lb) of wood per hour generates about 5.5 pg TEQ per second. Thus average JACADS dioxin emissions are similar to the combined emissions of four fireplaces. Finally, an average hazardous waste incinerator in the United States may

produce 1.1 ng/s or a TEQ emission rate of roughly 50 times greater than that of the average measurement for JACADS.

G.8 REFERENCES

AEHA (U.S. Army Environmental Hygiene Agency) 1992. *Inhalation Risk from Incinerator Combustion Products, Johnston Atoll Chemical Agent Disposal System, Health Risk Assessment*, 42-21-MQ49-92, Aberdeen Proving Ground, Md.

Birnbaum, L.S. and DeVito, M. J. 1995. "Use of Toxic Equivalency Factors for Risk Assessment for Dioxins and Related Compounds," *Toxicol.* **105**:391–401.

Brunner, C. R. 1985. *Hazardous Air Emissions from Incineration*, Chapman and Hall, New York.

BSM (name not given) 1992. "Dioxins & Their Cousins: The Dioxin '91 Conference," *Health & Env. Dig.* **5**:1–4.

Clark, D. A. et al. 1981. "Enhanced Suppressor Cell Activity as a Mechanism of Immunosuppression by 2,3,7,8-Tetrachloro-Dibenzo-*p*-Dioxin," *Proc. Soc. Exp. Biol. Med.* **168**:290–299.

Dewailly, E. et al. 1993. "Inuit Exposure of Organochlorines Through the Aquatic Food Chain in Arctic Quebec," *Environ. Health Perspect.* **101**:618.

Dourson, M. L. and J. F. Stara 1983. "Regulatory History and Experimental Support of Uncertainty (Safety) Factors," *Regul. Toxicol. Pharm.*, **3**:224–238.

Dourson, M. L. et al. 1985. "Novel Methods for the Estimation of Acceptable Daily Intake," *Toxicol. Indust. Health* **1**:23–33.

Egeland, G. M. et al. 1994. "Serum 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin's (TCDD) Effect on Total Serum Testosterone and Gonadotropins in Occupationally Exposed Men," *Am. J. Epidemiol.* **139**:272–281.

EPA (U.S. Environmental Protection Agency) 1985. *Health Assessment Document for Polychlorinated Dibenzo-p-Dioxins*, EPA/600/8-84/014F, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1987. *National Dioxin Study: Tier 4—Combustion Sources*, EPA-450/4-84-01h, Engineering Analysis Report, Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

EPA (U.S. Environmental Protection Agency) 1988. *A Cancer Risk-Specific Dose Estimate for 2,3,7,8-TCDD*, EPA/600/6-88/007Aa&Ab, and *Estimating Exposures to 2,3,7,8-TCDD*, EPA/600/6-88/005A, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1994. *Estimating Exposure to Dioxin-Like Compounds Vols. I, II, III* (External Review Draft), EPA/600/8-88-005Ca,b,c, Office of Research and Development, Washington, D.C., June, and *Health Assessment Document for 2,3,7,8-TCDD (TCDD) and Related Compounds* (Review Draft), Vol. 1 (EPA-600-BP-92-001A, OHEA-I-486-V13), Vol. 2 (EPA-600-BP-92-001B, OHEA-I-486-V2), and Vol. 3 (EPA-600-BP-92-001C, OHEA-I-486-V3), Office of Research and Development, Washington, D.C., June.

EPA (U.S. Environmental Protection Agency) 1995. *Summary of the Public Comments Received on the External Review Draft of the Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and Related Compounds,* (EPA/600/BP-92/001a, 001b, 001c) NCEA-95-W-002, National Center for Environmental Assessment, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1998. *The Inventory of Sources of Dioxin in The United States* (External Review Draft), EPA/600/P-98/002Aa, Exposure Analysis and Risk Characterization Group, National Center for Environmental Assessment, Office of Research and Development, Washington, D.C., April.

Gladen, B. C., et al. 1988. “Development after Exposure to Polychlorinated Biphenyls and Dichlorodiphenyl Dichloroethene Transplacentally and Through Breast Milk,” *J. Pediatr*. **113**:991–995.

Huisman, M. et al. 1995. “Perinatal Exposure to Polychlorinated Biphenyls and Dioxins and its Effect on Neonatal Neurological Development,” *Early Hum. Dev*. **41**:111–127.

Jacobson, J. L., S. W. Jacobson, and H. E. B Humphrey 1990. “Effects of In Utero Exposure to Polychlorinated Biphenyls and Other Contaminants on Cognitive Functioning in Young Children,” *J. Pediatr*. **116**:38–45.

A.T. Kearney, Inc. 1996. *Tooele Chemical Demilitarization Facility, Tooele Army Depot South, EPA I.D. No. UT5210090002, Screening Risk Assessment,* prepared by A.T. Kearney, Inc., San Francisco, Calif., for State of Utah Department of Environmental Quality, Division of Solid and Hazardous Waste, Salt Lake City, Utah.

Kociba, R. J. et al. 1978. “Results of a Two-Year Chronic Toxicity and Oncogenicity Study of 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin in Rats,” *Toxicol. Appl. Pharm.* **46**:279–303.

Koopman-Esseboom, C. et al. 1994. “Effects of Dioxins and Polychlorinated Biphenyls on Thyroid Hormone Status of Pregnant Women and Their Infants,” *Pediatr. Res.* **36**(4), pp. 468–473.

Löfroth, G. and Y. Zebühr 1992. “Polychlorinated Dibenzo-*p*-Dioxins (PCDDs) and Dibenzofurans (PCDFs) in Mainstream and Sidestream Cigarette Smoke,” *Bull. Env. Contam. Toxic.* **48**:789–794.

Lonky, E. et al. 1996. “Neonatal Behavioral Assessment Scale Performance in Humans Influenced by Maternal Consumption of Environmentally Contaminated Lake Ontario Fish,” *J. Great Lakes Res*. **22**:198–212.

Mably, T. A. et al. 1992. “*In Utero* and Lactational Exposure of Male Rats to 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin: 2. Effects on Sexual Behavior and the Regulation of Luteinizing Hormone Secretion in Adulthood,” *Toxicol. Appl. Pharmacol*. **114**:108–117.

Maronpot, R. R. et al. 1993. “Dose-response for TCDD Promotion of Hepatocarcinogenesis in Rats Initiated with DEN: Histologic, Biochemical, and Cell Proliferation Endpoints,” *Environ. Health Persp.* **101**:634–643.

Murray, F. J. et al. 1979. “Three-Generation Reproduction Study of Rats Given 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD) in the Diet,” *Toxicol. Appl. Pharmacol*. **50**:241–252 (as cited in I. C. T. Nisbet and M. B. Paxton, “Statistical Aspects of Three-Generation Studies of the Reproductive Toxicity of 2,3,7,8-TCDD and 2,4,5-T,” *Am. Stat.* **36**:290–298, 1982.)

Muto, H., and Y. Takizawa 1989. “Dioxins in Cigarette Smoke,” *Arch. Env. Health* **44**(3):171–174.

Muto, H., and Y. Takizawa 1992. “Potential Health Risk Via Inhalation/Ingestion Exposure to Polychlorinated Dibenzo-*p*-Dioxins and Dibenzofurans,” *Bull. Env. Contam. Toxic.* **49**:701–707.

Neubert, R. et al. 1990. “Polyhalogenated Dibenzo-*p*-Dioxins and Dibenzofurans and the Immune System: 1. Effects on Peripheral Lymphocyte Subpopulations of a Non-Human Primate (*Callithrix jacchus*) after Treatment with 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD),” *Arch. Toxicol*, **64**:345–359.

Neubert, R. et al. 1991. “Polyhalogenated Dibenzo-*p*-Dioxins and Dibenzofurans and the Immune System: 2. In Vitro Effects of 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD) on Lymphocytes of Venous Blood from Man and a Non-Human Primate (*Callithrix jacchus*),” *Arch. Toxicol.* **65**:213–219.

Neubert, R. et al. 1992. “Polyhalogenated Dibenzo-*p*-Dioxins and Dibenzofurans and the Immune System: 4. Effects of Multiple-Dose Treatment with 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD) on Peripheral Lymphocyte Subpopulations of a Non-Human Primate (*Callithrix jacchus*),” *Arch. Toxicol.* **66**:250–259.

Nisbet, I. C. T. and M. B. Paxton 1982. “Statistical Aspects of Three-Generation Studies of the Reproductive Toxicity of 2,3,7,8-TCDD and 2,4,5-T,” *Am. Stat.* **36**:290–298.

Pluim, H. J. et al. 1993. “Effects of Pre-and Postnatal Exposure to Chlorinated Dioxins and Furans on Human Neonatal Thyroid Hormone Concentrations,” *Environ. Health Perspect*. **101**:504–508.

Rier, S. E. et al. 1993 “Endometriosis in Rhesus monkeys (*Macaca mulatta*) Following Chronic Exposure to 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin,” *Fundam. Appl. Toxicol.* **21**:433–441.

Rier, S. E., A. K. Parsons, and J. L. Becker 1994. “Altered Interleukin-6 Production by Peritoneal Leukocytes from Patients with Endometriosis,” *Fertil. Steril*. **61**:294–299.

RPR (*Risk Policy Report*) 1997. “International Panel Concludes Dioxin is Known Human Carcinogen,” *Risk Policy Report* **3**(2):8, Feb. 21.

Roegner, R. H. et al. 1991. *Air Force Health Study: An Epidemiologic Investigation of Health Effects in Air Force Personnel Following Exposure to Herbicides. Serum Dioxin Analysis of 1987 Examination Results*, NTIS AD A-237-516 through AD A-237-524.

Rogan, W. J. et al. 1986. “Neonatal Effects of Transplacental Exposure to PCBs and DDE,” *J. Pediatr*. **109**:335–341.

Rogers, H. W. 1995. “Incinerator Air Emissions,” *Env. Health*, pp. 12–15, December.

SAB (Science Advisory Board) 1995. *Re-evaluating Dioxin, Science Advisory Board’s Review of EPA’s Reassessment of Dioxin and Dioxin-like Compounds*, EPA-SAB-EC-95-021, U.S. Environmental Protection Agency, Washington, D.C.

Safe, S. H. 1994. “Polychlorinated Biphenyls (PCBs): Environmental Impact, Biochemical and Toxic Responses, and Implications for Risk Assessment,” *Crit. Rev. Toxicol.* **24**:87.

Sauer, R. M. 1990. “2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin in Sprague-Dawley Rats,” submitted to Maine Scientific Advisory Panel, Pathco, Inc., Ijamsville, Md., Mar. 13 [cited in *Health Assessment Document for 2,3,7,8-TCDD (TCDD) and Related Compounds* (Review Draft), Vol. 1 (EPA-600-BP-92-001A, OHEA-I-486-V13), Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., June].

Sauer, P. J. et al. 1994. “Effects of Polychlorinated Biphenyls (PCBs) and Dioxins on Growth and Development,” *Hum. Exp. Toxicol*. **13**:900–906.

Schantz, S. L., D. A. Barsotti and J. R. Allen 1979. “Toxicological Effects Produced in Nonhuman Primates Chronically Exposed to Fifty Parts per Trillion 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD),” *Toxicol. Appl. Pharmacol*. **48**:A180.

Schantz, S. L. and R. E. Bowman 1989. “Learning in Monkeys Exposed Perinatally to 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD),” *Neurotoxicol. Teratol.* **11**:13–19.

Schantz, S. L., S. A. Ferguson, and R. E. Bowman 1992. “Effects of 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin on Behavior of Monkeys in Peer Groups,” *Neurotoxicol. Teratol.* **14**:433–446.

Schantz, S.L. 1996. “Developmental Neurotoxicity of PCBs in Humans: What Do We Know and Where Do We Go From Here?,” *Neurotox. Teratol.* **18**:217.

Silbergeld, E. K. 1995. “Understanding Risk: The Case of Dioxin,” *Sci. Am.*, pp. 48–57, November/December.

SRI (Southern Research Institute) 1991. *Results of the RCRA Trial Burn with GB Feed for the Liquid Incinerator at the Johnston Atoll Chemical Agent Disposal System*, SRI-APC-91-190-6967-006-F-R4, Birmingham, Ala., prepared for the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

Squire, R. A. 1980. “Pathologic Evaluations of Selected Tissues from Dow Chemical TCDD and 2,4,5-T Rat Studies,” submitted to Carcinogen Assessment Group, U.S. Environmental Protection Agency under contract no. 68-01-5092, Aug. 15 [cited in *Health Assessment Document for 2,3,7,8-TCDD (TCDD) and Related Compounds* (Review Draft), Vol. 1 (EPA-600-BP-92-001A, OHEA-I-486-V13), Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., June].

Travis, C. C. and S. C. Cook 1989. *Hazardous Waste Incineration and Human Health*, CRC Press, Inc., Boca Raton, Fla.

U.S. Army 1988. *Chemical Stockpile Disposal Program, Final Programmatic Environmental Impact Statement*, Vols. 1, 2, and 3, Program Executive Officer—Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

Weisglas-Kuperus, N. et al. 1995. “Immunologic Effects of Background Prenatal and Postnatal Exposure to Dioxins and Polychlorinated Biphenyls in Dutch Infants, *Pediatr. Res.* **38**:404.

Zarmakoupis, P. N. et al. 1995. “Inhibition of Human Endometrial Stromal Cell Proliferation by Interleukin 6,” *Hum. Reprod.* **10**:2395-2399.

ATTACHMENT G-1

EVOLUTION OF EPA PERSPECTIVE ON DIOXIN IMPACTS

1. EPA 1985

   No Observed Adverse Effects Level (NOAEL) for Non-Cancer Effects: A low observed adverse effects level (LOAEL) for non-cancer effects of 0.001 $\mu g \cdot kg^{-1} \cdot d^{-1}$ or 1 $ng \cdot kg^{-1} \cdot d^{-1}$ was identified, based on the three-generation rat reproduction study of Murray et al. (1979) as interpreted by Nisbet and Paxton (1982) (p. 14-11). The effects seen were on offspring survival and possibly on kidney anomalies. However, the Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel considered it a NOAEL (EPA 1988 App. C, p. 5).

   Reproductive and Developmental Toxicity: The 1985 EPA *Health Assessment Document for Polychlorinated Dibenzo-p-Dioxins* found that no conclusions could be drawn on dioxin-induced reproductive toxicity in humans (p. 9-36). However, it stated that "animal data clearly indicate teratogenic or fetotoxic effects in all animal species tested (p. 9-36)." Tetrachlorinated dibenzo-*p*-dioxin (TCDD) was characterized as the most potent teratogen known (p. 9-35), with a rat LOAEL greater than or equal to 100 $ng \cdot kg^{-1} \cdot d^{-1}$. Human evidence was insufficient for indicating teratogenic effects.

   Immunotoxicity: No discussion of immunotoxicity was given.

2. EPA 1988

   NOAEL for Non-Cancer Effects: Appendix C gives a fairly detailed analysis of the Murray et al. (1979) rat study that formed the basis for the non-cancer NOAEL. While rejecting the questionable statistical reanalysis of Nisbet and Paxton (1982), it concluded that the 1 $ng \cdot kg^{-1} \cdot d^{-1}$ value had to stand but that it should be considered "highly suspect" (p. 9) and was more likely a LOAEL, especially since data from rhesus monkeys were starting to appear suggesting effects at even lower dose levels (p. 8).

   Reproductive and Developmental Toxicity (Appendices C and D): Appendix C reviews other evidence for reproductive and developmental toxicity in animals. The document concludes that TCDD is a developmental toxicant, based on a large number of studies in a variety of species (p. 1). Long-term, low-dose exposure is a concern and acute and short-term exposures are also effective in causing adverse effects. A series of studies in Rhesus monkeys were highlighted as possibly indicating even greater sensitivity than the rat, as reproductive dysfunction was seen at 2 $ng \cdot kg^{-1} \cdot d^{-1}$ (50 ppt diet) for 7 months (Schantz, Barsotti, and Allen 1979) and preliminary results suggested effects at even lower doses (5 and 25 ppt) (pp. 7,8).

Appendix D contains a review of the epidemiological evidence for developmental and reproductive effects of TCDD exposure. It characterized the evidence from these studies as being open to question from a number of standpoints and inconclusive with respect to human effects (pp. 19, 20).

Immunotoxicity (Appendix E): Evidence for immunotoxicity is reviewed for both animal and human studies in this Appendix. Considerable evidence had accrued by this time for TCDD immunotoxicity in animals. One study in mice gave evidence of immunosuppressive effects at 4 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ (Clark et al. 1981), but these results were considered very questionable by EPA (p. 19). The document points out that the animal evidence suggested that the developing immune system may be more sensitive than the adult to TCDD-induced effects, thus possibly putting the very young at higher risk (p. 9).

With regard to humans, the reviewers concluded that at that time, the epidemiological literature failed to present "convincing evidence for altered immune function in the exposed populations" (p. 11). Among other criticisms, they noted that "there has been no report of an increase in clinical illness attributable to suppressed immune function" (p. 18).

3. EPA 1994

NOAEL for Non-Cancer Effects: p. 9-45: Current data suggest that the NOAEL in animals should be lower (than the 1 ng $TEQ{\cdot}kg^{-1}{\cdot}d^{-1}$). However, a new NOAEL value was not identified.

Reproductive and Developmental toxicity: p. 5-73: "In adult rats, the most sensitive toxic responses to TCDD have been observed following long-term, low-level exposure." The document also points out that there is far less interspecies variation for prenatal effects than for postnatal ages (p. 5-59).

p. 7-249 ff: Three epidemiological studies were considered and two were considered to show significant associations as stated on p. 7-250: "Results are limited by the cross-sectional nature of the data and type of clinical assessments conducted. However the available data provide evidence that alterations in human male reproductive hormone levels are associated with serum TCDD." p. 9-51: "If these data continue to hold up in future observations, their clinical significance will need to be further evaluated."

Other reproductive effects including spontaneous abortions and congenital malformations in humans are listed as possible effects but not conclusive. Increased neonatal deaths suggested by Ranch Hand study, maternally-mediated effects of dioxin exposure on birth defects indicated by Vietnamese studies, and sperm abnormalities (Vietnam Experience Study) as well as effects on male reproductive hormone levels are said to need more study.

Immunotoxicity: p. 4-32: In animals, the "gold standard" test is for humoral immunity [plaque-forming cell response to sheep red blood cells (SRBCs)]. It is depressed by TCDD in several species, the only endpoint consistently suppressed across species including nonhuman primates. The only exception is an enhancement in rats in 1 study. The toxicity equivalent factors for congeners are based on the dose producing 50% suppression of the anti-sheep red blood cell response in Ah-responsive B6 mice, although responses are not as consistent for other congeners as for TCDD.

New information from animal studies includes insight into mechanism of TCDD and PCB-induced hypersensitivity to endotoxin and also evidence of TCDD-enhanced susceptibility of mice and rats to viral and parasitic diseases (evidence of decreased host resistance to bacterial diseases had been published by 1984). More studies, also in non-human primates, have accrued; a study in marmosets showed that one cannot extrapolate from high to low doses, as directions of effects reversed (Neubert et al. 1990, 1991, 1992) (p. 4-30).

p. 7-261: Too little information to suggest definitively that TCDD, at the levels observed, is an immunotoxin in humans. p. 4-35: Evidence of immunotoxicity in humans is inconsistent, but may be due largely to methodological problems. p. 9-50: "Epidemiological studies provide also conflicting evidence…. Few changes in the immune system in humans associated with dioxin have been detected when exposed humans have been studied."

Other: p. 7-245: Increased gamma glutamyl transferase (GGT) levels; GGT is the only liver enzyme consistently increased in exposed humans; it is not a specific effect, as it is raised in almost all hepatobiliary diseases. The clinical significance here is unclear as long-term pathologic consequences of elevated GGT have not been demonstrated.

p. 247: Concludes that there is a slight but statistically significant or borderline significant risk of developing diabetes or having an elevated fasting serum glucose level associated with dioxin exposure. p. 9-51: Points out that there are no animal data to corroborate such an effect, and while elevated serum glucose might indicate increased risk of developing diabetes, the traditional risk factors appear to be much more important than TCDD exposure.

New Conclusions Regarding Human Health Effects: EPA 1994, Vol. III (Chap. 9), p. 9–81: " … It is not currently possible to state exactly how or at what levels humans in the population will respond, but the margin of exposure between background levels and levels where effects are detectable in humans in terms of toxic equivalents *is considerably smaller than previously estimated*." (Emphasis added)

EPA 1994, Vol. III (Chap. 9), p. 9-87: "Based on all of the data reviewed in this reassessment…a spectrum of effects. Some of these effects may be occurring in humans *at very low levels, and some may be resulting in adverse impacts on human health*." (Emphasis added)

In addition to these, the identification of effects on male reproductive hormones, of a slight risk of diabetes or elevated fasting serum glucose level and of elevated GGT are new findings.

4. EPA SAB 1995.

NOAEL for Non-Cancer Effects: p. 59 “In summary, the current NOAEL of 1 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ rests on a debatable foundation, and it would be appropriate to reevaluate it.” The Committee listed the evidence of developmental neurotoxicity in Rhesus monkeys at a LOAEL of 0.125 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$, the frank effects level for developmental reproductive effects in male rat offspring at an estimated 34 ng/kg body burden, and several other lines of evidence supporting the need to reevaluate the NOAEL. Among these were studies of developmental neurotoxicity in human infants that had been omitted from consideration in the EPA 1994 document (see below).

Developmental Toxicity Effects: The SAB was critical of the omission of any consideration of the work on developmental neurotoxicity in human infants (e.g., Jacobson, Jacobson, and Humphrey 1990; Rogan et al. 1986; Gladen et al. 1988), particularly because these studies involved exposure at environmental levels, although at higher than general background. They also recommended consideration of a study by Huisman et al. (1995) reporting effects on newborns of intrauterine exposure to TCDDs and tetrachlorodibenzofurans (TCDFs) as well as polychlorinated biphenyls (PCBs). (See SAB 1995, Table 2.2).

Immunotoxicity: p. 60 “Although the immune system is a sensitive target to halogenated aryl hydrocarbons in experimental animal species, as presented, the EPA document does not provide convincing evidence to indicate that background or near background exposure levels to dioxin-like compounds in industrial countries are sufficient to affect the immune system.”

p. 61 “ The ‘gold-standard’ test (i.e., suppression of the primary antibody response following immunization) was not employed in any of the human test panels, although this is a hallmark in experimental animals.” [except for Dewailly’s study on Inuit women (Dewailly 1993)] Thus, the literature on humans isn’t as helpful as would be desirable; lack of data may be due to largely due to methods used and long time gaps between exposure and assessment of immune system function.

Dose Response Issues: p. 65 “This fundamental issue concerns the basis for the selection of the dose-response relationship to be used in assessing the (non-cancer) adverse effects of dioxin…”

p. 66: …The available information on TCDDs suggest that use of the benchmark approach, rather than the reference dose, is probably more appropriate…The Committee recommends that EPA work towards developing and implementing a methodology that would allow the assessment of non-cancer risk resulting from incremental exposures.

Continuum of Response Postulate: p. 66: EPA postulates a continuum of response…. The statement is far too general…could be taken as implying that all (or any) early changes will necessarily lead to ultimate toxicity. The statement is only defensible in reference to a limited number of specific case examples, but cannot be taken as universally proven. Not a postulate but a current hypothesis. That Ah receptor may be a sensing pathway, not a part of toxic response of cell to TCDD was not considered.

Margin of Exposure: p. 77 : The last sentence…[smaller margin of exposure] is (in the opinion of most, but not all of the EPA Science Advisory Board Committee) thought to be speculative and needs to be reexamined.

p. 78: In regard to the EPA 94 conclusion on effects at very low levels and possible adverse impacts: It is difficult to determine what EPA is inferring in that last sentence…("Some of those effects may be occurring in humans at very low levels, and some may be resulting in adverse impacts on human health") "If it is intended to state that adverse effects in humans may be occurring near current exposure levels, it is the Committee's judgement that EPA has not presented findings that support this conclusion adequately."

APPENDIX H

APPROACH TO THE ASSESSMENT OF IMPACTS FROM POTENTIAL ACCIDENTS

Introduction. This appendix contains information about the consequences of hypothetical accidents that could occur either during the continued storage of munitions filled with mustard agent (i.e., agent HD) at the Pueblo Chemical Depot (PCD) or during the proposed destruction of these munitions. The approach to the assessment of impacts from such accidents is described in this appendix. Information regarding the quantity of released material (i.e., the "source term") is also presented in this appendix and has been incorporated directly into the assessment of impacts in Sect. 4 of this Environmental Impact Statement (EIS).

To assess the environmental impacts of accidents and the accidental release of chemical agent, it is necessary first to identify the hypothetical accident scenarios that could occur. The evaluation of the consequences of such a hypothetical accident then begins with a determination of the quantities of chemical agent that could be potentially released in the associated scenarios. The evaluation also requires an understanding of the method by which the mustard agent is released into the environment: it can be spilled, vaporized by an explosion, lofted by a fire, or released by some combination of these modes. Furthermore, the accident analysis requires information on the duration of release. The ways in which the chemical agent is dispersed after a release are called "environmental pathways." Once the spatial extent of the hypothetical accident and the environmental pathways are defined, the magnitude of potential impacts to humans or to the environment can be identified, quantified, and/or evaluated through dose-response assessments.

This appendix describes hypothetical accident scenarios specific to the PCD. For the purposes of the environmental review in this EIS, a single, bounding accident is identified and described for further detailed analysis. This appendix closes with an assessment of the potential impacts of the bounding accident upon human health. The assessment of other impacts—particularly to ecological resources—is contained in Sect. 4 of this EIS.

Basis for Revisions Since the Draft EIS. The analysis of accidents in this appendix differs from the analysis presented in the draft version of this EIS (i.e., the PMCD Draft EIS, herein called the DEIS). The differences are related to the different approaches taken and the different results obtained by the two sets of analysts for the DEIS and the Draft EIS for the Assembled Chemical Weapons Assessment (ACWA) program (ACWA 2001). The analysis in this Final EIS (FEIS) is more consistent with the analysis in the ACWA Final EIS. The primary differences in this analysis, as compared to the analysis in the DEIS, are as follows:

- The use of "accident categories" in the DEIS to describe the maximum downwind extent of an accident has been discontinued in this FEIS. Instead of "accident categories," this FEIS uses the actual downwind lethal hazard distances as computed by the Army's atmospheric dispersion code.
- A more recent database of hypothetical accidents has been used to define the quantities (and release modes) of mustard agent released to the environment during an accident. The DEIS used data from a 1987 risk assessment. This FEIS uses data from a 1996 quantitative risk

assessment (see SAIC 1996). The quantity of accidentally released agent, as used in this FEIS, is less than what was used in the DEIS.

- In accordance with the most-recent Army guidance, a numerically lower airborne concentration of mustard agent is used in this FEIS to define the "50% lethality dose" (i.e., 600 mg-min/m^3 instead of 1500 mg-min/m^3).

The net result of the changes made to the DEIS analysis is the reduction of the 50-km (31-mile) zone of potential impact (as identified and described in the DEIS) to 30 km (19 miles) in this FEIS. The specifics of the hypothetical accident producing this zone of impact are presented and discussed below.

H.1 ACCIDENT SCENARIOS

A hazard is generally defined as a source of danger, injury, or death for humans, animals, or the environment. In the context of the proposed destruction activities and/or continued storage at PCD, a hazard initiates a sequence of events (also called a "scenario") leading to an accidental release of mustard agent. The analysis of hazards and accident scenarios in this EIS is solely intended to provide estimates of the extent of the zone of potential impact from hypothetical accidents at PCD. As such, the accident analysis presented in this appendix should not be considered to be a detailed safety assessment or a substitute for a detailed risk assessment.

A detailed risk analysis (MITRE 1987) was conducted for the Final Programmatic Environmental Impact Statement (FPEIS) for the Chemical Stockpile Disposal Program (CSDP). "Risk" was defined as the mathematical product of the probability of a hypothetical accident and its potential consequences (as measured by impacts, such as potential human fatalities or the size of the area covered by the lethal portion of the plume). "Risk" can thus be used to identify the acceptability of potential impacts to resources, as well as to develop mitigation measures for those impacts.

In 1996, the Army updated the FPEIS's probabilitistic risk assessment with a site-specific version of a Quantitative Risk Assessment (QRA) (see SAIC 1996) for a baseline incineration facility at PCD. The QRA utilized the latest methods and approaches for systematically identifying and assessing potential sources of risk. The QRA utilized site-specific probabilistic weather conditions and detailed seismic assessments of the baseline chemical destruction facility and the storage igloos. The data from the 1996 QRA provide the basis for the assessment of accidents in this appendix.

Although the proposed destruction activities are not without risk to the human and ecological environment (see Sect. 4), the risks of on-site destruction at PCD are reasonably low and are greatly exceeded by the risks of continued storage (U.S. Army 1988a; SAIC 1996). For example, the QRA found that the risk[1] of public fatalities around PCD is 5.9×10^{-6} for 20 years of continued storage and is 7.2×10^{-8} for munition destruction operations (SAIC 1996). The QRA

[1]"Public fatalities risk" is a numerical representation of the average risk over all hypothetical accident scenarios and their potential consequences. Mathematically, the risk is a summation of the products of the accident sequence probabilities and their associated consequences. The risk of an infrequent accident with large consequences can therefore contribute equally with a more frequent accident having smaller consequences.

also found that the probability of incurring one or more public fatalities is approximately 1 in 1 million for continued storage and 1 in 1 billion for stockpile destruction activities.

The accident analysis for the proposed action concentrated on several activities associated with the proposed chemical weapons destruction activities, as well as the continued storage of the inventory at PCD. Accident initiators included human error and equipment failures, as well as external events (e.g., aircraft crashes, seismic events, tornadoes and high winds, and lightning). The impact analyses are based on the accidents that are specific to the implementation of each alternative under consideration in this EIS. In all cases, the impact analyses are based on "credible accidents." As in previous PMCD EISs, a credible accident is defined in this study as an accident with a probability equal to or greater than 10^{-8} (or 1 in 100 million).

H.1.1 Continued Storage

As part of the assessment of risk in the QRA, an analysis was performed to identify those hypothetical accidents that might occur during the continued storage of chemical munitions at PCD (SAIC 1996). The greatest concern for impacts following a storage accident would be the airborne hazard created by atmospherically dispersed mustard agent.

The QRA found that potentially serious accidents during continued storage at PCD are related primarily to externally-initiated events, such as aircraft crashes or earthquakes. In the QRA, aircraft crashes accounted for almost 100% of the acute fatality risk to the public during storage at PCD, while earthquakes accounted for much, much less than 1%. As described in Sect. H.3.1.1 of this appendix, an aircraft crash into a storage igloo was identified and selected for further analysis in this EIS.

Internally-initiated events, such as handling accidents, would include dropping of munitions and forklift collisions resulting in puncture or fire; however, none of these internally-initiated events were found to produce lethal plumes that would propagate as far downwind as the plumes from the largest externally-initiated events (SAIC 1996; SAIC 1997). In addition, the QRA determined that the contribution to the total storage risk from handling accidents was significantly less than 1%.

H.1.2 Destruction of Chemical Munitions

Accidents associated with the proposed destruction activities include those that might occur during the handling of munitions, the transport of munitions between the storage igloo and the destruction facility, and inside the proposed destruction facility. Accidents that might occur in the existing storage area during the on-site destruction period would be the same as those that might occur during the continued storage of munitions at PCD. The analysis of storage accidents has been deliberately separated from the analysis of on-site destruction accidents to facilitate the comparison between the destruction alternatives and the no-action alternative (i.e., continued storage).

H.1.2.1 Non-Incineration Technologies

The ACWA Draft EIS (ACWA 2001) provides the only information available for the identification or assessment of hypothetical accidents that could occur during the destruction of the PCD stockpile with non-incineration technologies. No detailed risk assessment has yet been conducted for the ACWA technologies; however, a bounding accident was used in the ACWA

Draft EIS to define the magnitude and spatial extent of an accidental release of chemical agent. As described in detail in Sect. H.3.1.2 of this appendix, an aircrash into the Container Handling Building (CHB)—where munitions inside on-site transportation packages would be received at the proposed destruction facility—was identified by the ACWA staff as an appropriate hypothetical event for analysis.

H.1.2.2 Incineration Technologies

The QRA concludes that the public risk of munitions destruction at PCA is dominated by external events, such as earthquakes and aircraft crashes. In particular, earthquake-initiated accidents account for 88% of the destruction processing risk, and air crashes account for 12%. All other contributors to the risk of chemical weapons destruction at PCD account for much, much less than 1% of the total risk in the QRA.

Because the earthquake-initiated accidents dominate the risks of chemical weapons destruction at PCD, the largest earthquake-induced accident was identified and selected for further analysis in this FEIS. This event is described in detail in Sect. H.3.1.2 of this appendix.

H.2 ENVIRONMENTAL PATHWAYS

Mustard agent can be dispersed after an accidental release through various environmental pathways. The basic pathways include movement of small droplets in the air; movement of vapor in the air; deposition or scavenging of the airborne material onto underlying land, vegetation, or water; movement into bodies of surface water after atmospheric deposition or through runoff of spilled agent; and movement into groundwater (for example, as the result of aquifer recharge from contaminated surface waters). Once mustard agent is released into the environment, it may affect human health, ecological systems, water use, and/or socioeconomic resources. The dispersion processes determine the form and level of the contaminant in the environment and, in turn, the response of various ecological systems to the contaminant.

The greatest immediate concern for impacts following a release of mustard agent would be the airborne hazard. In addition, spilled liquid agent could also impact surface areas and/or surface water and groundwater resources.

H.2.1 Atmospheric Dispersion Analysis

Potential accidental releases were analyzed using an air dispersion model developed by the U.S. Army's Chemical Research Development and Engineering Center. This model, a computer code named D2PC (Whitacre et al. 1986), incorporates detailed information on the type of accident, type of agent, type of release (e.g., explosion, fire, or spill), and duration of release. The latest version (ACS 2000) of this computer code, now called D2PCw, was used for the analyses in this EIS. The D2PCw code incorporates atmospheric assumptions that have been extensively documented and are currently in use in a variety of other atmospheric dispersion models. A vapor depletion technique is also included in D2PCw to estimate the removal of agent vapor from the atmosphere by deposition or scavenging by surfaces.

Atmospheric dispersion, as well as the spatial extent of impacts, could vary considerably according to meteorological conditions during an accidental release. Worst-case (WC) meteorological conditions are credible conditions that result in near-maximum downwind doses. The WC conditions presume a stable atmosphere [stability Class E (Pasquill 1961)] with a wind speed of 1 m/s (2.2 mph). Conservative most-likely (CML) conditions are frequently occurring meteorological conditions that provide greater dispersion (i.e., dilution) of agent but can still result in relatively large downwind lethal hazard distances. CML conditions presume a neutral stability (Class D) with a wind speed of 3 m/s (6.7 mph). A specified quantity of mustard agent accidentally released under WC conditions would result in a greater downwind distance for the no-deaths concentration and a greater number of potential fatalities than the same release under CML conditions.

The D2PCw code predicts the inhalation dose of agent expected at locations downwind from the point of the release. (Dosage is defined as the mathematical product of airborne agent concentration and the duration of exposure.) The D2PCw code was used in this EIS to estimate airborne concentrations of mustard agent that could result in human fatality rates of 0%, 1%, and 50%. The dosage corresponding with the 0% rate—also known as the "no-deaths" dose—is the largest dosage that would be expected to result in no fatalities to exposed healthy adult males.

For this analysis, the dosage level corresponding to 50% lethality was assumed to be 600 mg-min/m^3. The dosage levels corresponding to 1% lethality and "no-deaths" were assumed to be 150 mg-min/m^3 and 100 mg-min/m^3, respectively. These latter two values are the default values in the D2PCw model. All three of these dose values were obtained from previous recommendations by the U.S. Army Chemical and Nuclear Agency (USANCA 1994) and are the same as the values used in the QRA for PCD. A breathing rate of 25 L/min is associated with each of these doses.

The downwind distances used in this analysis are for locations along the center of the plume or cloud of agent as it travels downwind. Doses of agent are greater along this centerline than to either side and are predicted by the D2PCw code to decrease from the centerline according to a Gaussian distribution. Contours can be drawn graphically to depict a given dosage; these contours form an ellipse (see Fig. H.1). The shape of the ellipse is dependent on the meteorological conditions, as defined above.

The D2PCw model provides conservative estimates of (i.e., it overestimates) the region impacted by atmospheric dispersion of chemical agent because (1) no credit is taken for the potential confinement of the atmospheric plume by terrain effects, and (2) the selected meteorological conditions are assumed to persist invariably over the entire dispersion period [for example, over 8 hours would be needed for winds blowing at 1 m/s (2.2 mph) to reach 30 km (19 miles)]. The D2PCw modeling results are subject to several qualifications (e.g., estimates of downwind no-death distances are accurate to within ±50%), as documented in Sect. H.3.2.

H.2.2 Deposition Analysis

Surface deposition or scavenging of mustard agent from atmospheric releases is of interest in terms of contamination of ecological resources, surface water, and physical aspects of the socioeconomic environment. To evaluate the effects of deposition or scavenging from an airborne plume of accidentally released chemical warfare agent, the amount of material deposited can be estimated by multiplying the airborne concentration by a deposition velocity. The chemical agent was assumed to be uniformly deposited over the area based on the concentration and the time of cloud passage. These resulting deposition rates are used in Sect. 4 of this EIS to assess the impacts to ecological resources. However, because deposition calculations are quite imprecise (see U.S. Army 1988, Vol. 3, Appendix K), the estimated values can only be assumed to be accurate to within about one order of magnitude.

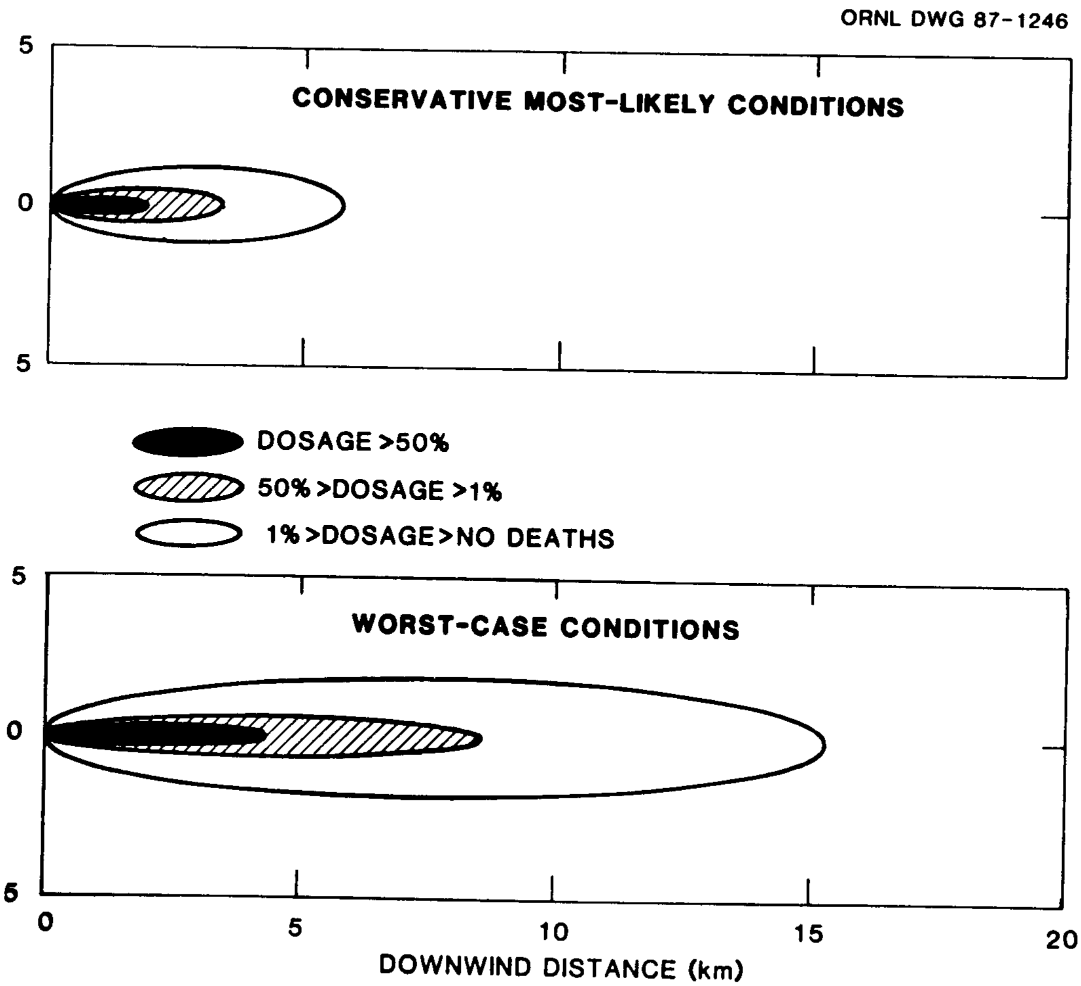


Fig. H.1. A hypothetical scenario illustrating the relationships between plume distances and shapes for accidents releasing the same quantity of chemical agent under different meteorological conditions.

H.2.3 Spills

A spill of mustard agent is the release mode by which the largest impacts might be produced in surface waters or groundwater. Surface waters could be contaminated in four ways: (1) a spill might cause agent to directly enter surface water—for example, a spill could migrate into a drainage ditch or small tributary of a waterbody; (2) agent might be deposited from an airborne plume or cloud onto surface water; (3) if a heavy rain or snowmelt occurred shortly after an accident, agent could be washed into surface waters in runoff from land that had been contaminated by the spill or by atmospheric deposition or scavenging; and (4) contaminated groundwater might discharge to surface waters and carry agent back to the surface.

Mustard agent could reach groundwater if agent on contaminated land were carried by water infiltration into the soil and percolated downward. In addition, agent could reach groundwater from contamination of surface water because some groundwater is recharged by surface waters.

H.3 CONSEQUENCES OF ACCIDENTS

The accident database from the QRA (SAIC 1997) is used by the Chemical Stockpile Emergency Preparedness Program (CSEPP) to assist with planning around PCD. The accident database identifies and describes each accident scenario from the QRA, as well as its associated source term.

An organizing concept for CSEPP planning is a set of emergency response zones. In regard to the relationship between hypothetical accident distances and CSEPP, the boundaries of emergency planning zones under CSEPP are based primarily on the time-distance relationships that would be associated with accidental releases of chemical warfare agent. Other factors considered in the determination of CSEPP planning zones include theoretical plume arrival times, the distribution of people and resources around the depot, and other geopolitical information. The determination of CSEPP planning zone boundaries is ultimately made by local and state authorities. Although the Army does not encourage state and local planners to ignore worst case accidents (i.e., those resulting from catastrophic events, such as lightning strikes, earthquakes or airplane crashes), the Army, the Federal Emergency Management Agency, and other CSEPP participants have elected to use more credible hypothetical accidents (i.e., those having a higher probability of occurrence) for their emergency planning basis. Hence, there may be differences between the accidents used as a basis for CSEPP planning and those used to bound environmental impacts in this EIS.

The accidents in the QRA database for PCD were examined for further analysis in this FEIS (see SAIC 1997). The largest of those hypothetical events are identified and described below.

H.3.1 Identification of Worst-Case Accidents

The impact analyses in this EIS are based on hypothetical accidents that are specific to the implementation of alternatives under consideration in this EIS. The hypothetical accidents associated with continued storage of munitions at PCD would potentially involve entire igloo quantities of mustard agent. Because the destruction alternatives (i.e., either neutralization or incineration) would involve far less mustard agent than exists in a storage igloo, the largest hypothetical storage accident is used in this FEIS to bound the potential environmental impacts of accidents under all alternatives. The largest such hypothetical accidents (also called "worst-case accidents") are identified in Table H.1 and are described below.

To assist the reader in understanding the information contained in the various portions of this appendix, Table H.1 also shows the potential numbers of fatalities that might accompany the hypothetical accidents. The fatality data were obtained from the analysis described in Sect. H.3.2.

H.3.1.1 Hypothetical Storage Accidents

For the alternative of continuing to store the chemical weapons at PCD without their destruction, the largest hypothetical accident [as identified in the QRA database (SAIC 1997)] would involve an aircraft crash into a storage igloo filled with either 4.2-inch mortar rounds or 155-mm projectiles. This event was postulated to result in a fire involving the entire contents of a single igloo. The amount of mustard agent released to the atmosphere during this event is given in the QRA database as 6,800 kg (15,000 lb) detonated and 1,650 kg (3,640 lb) released by fire in 20 minutes. The QRA database assigns an annual frequency of between 1.1×10^{-6} and 2.9×10^{-7} to this event. This is equivalent to about one chance (or less) in 900,000 per year of continued storage.

The downwind no-deaths distance for this hypothetical accident (as modeled in this appendix) would be 30 km (19 miles) under WC meteorological conditions. Under CML meteorological conditions, the downwind no-deaths distance would be 5.4 km (3.4 miles).

H.3.1.2 Hypothetical Accidents during the Destruction of Chemical Munitions

Non-Incineration Technologies. The hypothetical accident identified in the ACWA Draft EIS (ACWA 2001) for a non-incineration pilot facility assumes that an aircraft crashes into the Container Handling Building (CHB) and a subsequent fire occurs. For this accident scenario, the assumed maximum amount of agent that could be stored in the CHB was used to estimate the maximum release that could result from an aircraft crash accident. The ACWA staff estimated the source term for this accident from documentation for an incineration facility. The CHB was assumed to contain 4.2-inch mortar rounds at the time of the crash. The facility accident, as identified and modeled by the ACWA staff, has been adopted for use in this appendix without further analysis. This includes both the ACWA estimates of downwind hazard distances and the estimated numbers of potential fatalities.

Incineration Technologies. The largest hypothetical accident identified in the QRA for a PCD incineration facility assumes that an earthquake with an ensuing fire affects the inventory of 4.2-inch mortar rounds located in the munitions demilitarization building, the unpack area, and the CHB. The source term for this accident scenario was estimated in the QRA to be 385 kg (849 lb) released over 13 hours by evaporation, 114 kg (251 lb) released by detonation, and 0.6 kg (1.3 lb) released over 24 hours through the facility's ventilation and filtration system. The downwind no-deaths distance for this accident, as computed for this appendix, is 8.6 km (5.3 miles) under WC meteorological conditions. The QRA database assigns an annual frequency of 8.2×10^{-7} to this event. This is equivalent to about one chance in 1.2 million per year of facility operations. Under CML conditions, this same hypothetical accident would produce a downwind no-deaths distance of 4.3 km (2.7 miles); however, no off-site fatalities would be expected from this event.

Table H.1. Hypothetical accidents involving the largest credible releases of mustard agent at the Pueblo Chemical Depot

Accident scenario description	Munition type	Conservative Most-Likely (CML) meteorological conditions[a]			Worst-Case (WC) meteorological conditions[b]		
		Computed downwind lethal distance[c], km (miles)	Estimated average number of potential fatalities[d]	Estimated maximum number of potential fatalities[e]	Computed downwind lethal distance[c], km (miles)	Estimated average number of potential fatalities[d]	Estimated maximum number of potential fatalities[e]
STORAGE ACCIDENT[f]							
Aircraft crash into storage igloo (with ensuing fire)	4.2-inch mortar rounds or 155-mm projectiles	5 (3)	0	2	30 (19)	9	290
ACWA (i.e., NON-INCINERATION) FACILITY ACCIDENT[g]							
Aircraft crash into facility (with ensuing fire)	4.2-inch mortar rounds	2 (1)	N/A	0	9 (5)	N/A	2
PMCD (i.e., INCINERATION) FACILITY ACCIDENT[f]							
Earthquake at facility (with ensuing fire)	4.2-inch mortar rounds	4 (3)	0	0	9 (5)	0	2

[a]Conservative Most-Likely meteorological conditions are stability class D with a wind speed of 3 m/s.
[b]Worst-Case meteorological conditions are stability class E with a wind speed of 1 m/s.
[c]The distance to where the airborne concentration is equal to the concentration at which no deaths would be expected to occur (i.e., the 0% lethality dose).
[d]This the average number of potential fatalities as computed from 360 possible plume directions around the location of the accident.
[e]This the largest numerical value of potential fatalities as computed from a set of 360 possible plume directions around the location of the accident.
[f]The computed distances were obtained from the D2PCw model by using the source terms described in SAIC (1997).
[g]All data were obtained from Table 6.21-2 in the ACWA Draft EIS (ACWA 2001).

H.3.2 Estimation of Potential Fatalities from Mustard Agent Releases

The human health impacts of an accidental release of mustard agent stored at PCD would include fatalities and sublethal effects. Because sublethal effects would vary with the exposure concentrations, the exposure duration, and the health status and number of people exposed, it would be impossible to attempt to definitively quantify such effects. In contrast, the number of potential fatalities would vary directly with the accident size and the population exposed, both of which can be readily quantified.

Estimates of potential fatalities require (1) a description of the population distribution around the accident site, (2) a description of how large an area would be affected by chemical agent if an accident were to occur, and (3) a method of combining these descriptions to produce an estimate. Each of these elements is described in the paragraphs below.

Off-post Populations. For this FEIS, the year 2000 census data (U.S. Department of Commerce 2001) were used to develop estimates of the spatial distribution of the residential population around PCD. The approximate location for the proposed destruction facility was used as the center for the off-site population. The coordinates of this location are 38°, 20 minutes, 34 seconds north latitude and 104°, 18 minutes, 29 seconds west longitude.

The year 2000 census information contains population counts by location (i.e., by latitude and longitude) for various hierarchical data levels down to the individual block level (e.g., a neighborhood area bounded by four streets). For this analysis, the block level data were used. Table H.2 shows the distribution of residential population obtained from the block-level census data.

Dose Contours and Fatality Rates. The area affected by a plume from an accident depends upon the meteorological conditions at the time of release, the amount of agent released (also called the “source term”), and the manner in which it is released. This input was obtained from the QRA risk assessment [as reported in SAIC (1997)]. The plume shape was obtained by using these inputs with the D2PCw atmospheric dispersion model described in Sect. H.2.1.

The computational methodology used to estimate fatalities assumed that any person at the point of the release would have a 100% probability of dying. Farther downwind from the point of the release—as the airborne agent disperses—a boundary exists as defined by the 50% lethal dose (see Fig. H.1). That is, people on this boundary would have a 50% chance of dying from exposure to the chemical agent. It was assumed that the entire population within the area between the point of release and the 50% lethal dose boundary would receive a dose midway between the 100% and 50% levels. Therefore, the fatality rate would be 75% for this population.

A similar assumption was made at the lower dose levels. Thus, it was assumed that the fatality rate for persons who would receive exposures between the 50% lethal dose and the 1% lethal dose would average 25%, and that the fatality rate for persons receiving exposures between the 1% lethal dose and no-deaths dose would be 0.5%. These are conservative assumptions that tend to overestimate the number of fatalities, because the time-weighted dose-concentration declines at a greater-than-linear rate as downwind distance increases, and because the dose per unit area also declines at a greater-than-linear rate as downwind distance increases.

Plume Overlays. To estimate the potential maximum fatalities for a specific accident category, the 50%, 1%, and no-deaths dose contours from the D2PCw atmospheric dispersion model were overlain on the census-based population around PCD; the number of persons within each of the three plume contours was counted; and the number of fatalities was computed using the fatality rates previously described. The downwind plume direction was then rotated in increments

Table H.2. Distribution of residential population around the location of the proposed munitions destruction facility at the Pueblo Chemical Depot

	Incremental population between specified distances (km)[a]					
Direction	**0 to 2**	**2 to 5**	**5 to 10**	**10 to 15**	**15 to 20**	**20 to 30**
North	0	0	0	66	0	7
North-Northeast	0	0	0	0	8	12
Northeast	0	0	0	0	23	24
East-Northeast	0	0	0	0	6	41
East	0	0	0	24	5	22
East-Southeast	0	0	0	0	0	26
Southeast	0	0	0	0	8	133
South-Southeast	0	0	0	376	182	52
South	0	0	18	317	111	32
South-Southwest	0	0	15	839	128	343
Southwest	0	0	0	109	1,155	1,088
West-Southwest	0	0	0	4	2,105	54,353
West	0	0	0	0	0	16,278
West-Northwest	0	0	0	0	0	161
Northwest	0	0	0	0	0	7
North-Northwest	0	6	0	0	0	110
Incremental total	**0**	**6**	**33**	**1,735**	**3,731**	**72,689**
Cumulative total (through specified distance)	**0**	**6**	**39**	**1,774**	**5,505**	**78,194**

Note: The location used for the center of the above population lies at 38°, 20 min, 34 sec north latitude and 104°, 20 min, 34 sec west longitude.

[a]Multiply kilometers by 0.6214 to obtain miles.

Source: U.S. Department of Commerce 2001. *2000 Census of Population, SF1 Data Files (on CD-ROM)*, Bureau of the Census, Government Printing Office, Washington, D.C.

of one compass degree around the point of release, and the estimate of fatalities was recomputed at each increment. This process was repeated for the full 360° around the site to identify which wind direction would cause the largest number of potential fatalities. Two numbers were obtained from this calculation: (1) the average number of potential fatalities for all 360 plumes and (2) the maximum number of potential fatalities from the set of all 360 plumes. The resulting fatality estimates for each hypothetical accident are shown in Table H.1.

These estimates of potential fatalities are subject to several qualifications as documented in the FPEIS (U.S. Army 1988, Vol. 1, Sect. 4.2.3.1):

- As noted above, the assumption that 75%, 25%, and 0.5% of the population would die within a dose-exposure contour is conservative (i.e., it over-predicts the actual fatality rates).
- The estimates of fatalities are based on dose data that characterize the expected response of healthy young males. To accommodate the suspected differences in individual sensitivity among the general public, Sect. H.4 presents results of a sensitivity analysis of the fatality estimates over a range of hypothetical sensitivities within the overall population.
- The downwind distance estimates from the D2PCw atmospheric dispersion code are accurate only to within about ±50%. As a result, the fatality estimates (which are affected by area, as well as distance relationships) based upon these distances have corresponding ranges on the order of about -75% to +25%.
- Real variations in wind speed and/or direction during a release would cause the plume from an accident to have a more complex shape over real terrain than the elliptical, straight-downwind shape used here.
- The census data used for determining the population distribution reflect places of residence, and the fatality estimates for a given accident category are thus more representative of nighttime than of daytime accidents.

It was further assumed that no emergency response or protective actions would occur around PCD in response to an accident. The human health impacts are therefore expressed in numbers of potential fatalities without any credit for possible reductions due to such actions. Hence, the estimated number of potential fatalities in this appendix are likely to exceed those that would actually be experienced in the unlikely event of an accident. The values in Table H.1 can therefore be considered to represent an upper bound on the potential number of fatalities that might result from an accidental release of mustard agent.

H.4 SENSITIVITY OF FATALITY ESTIMATES TO DOSE-RESPONSE VALUES AND DISTRIBUTION OF SENSITIVE POPULATIONS

The toxicological data (see U.S. Army 1988; Vol. 3, Appendix B) used in developing the above estimates of potential fatalities considered only acute lethality for healthy adult males. Such data are understood to be appropriate for quantitative evaluation of dose response; however, the dose response of a more precise cross section of the population could result in different estimates of potential fatalities. Specifically, infants, children, or the elderly may die from exposure to doses lower than the estimated no-deaths dose for healthy adult males. A sensitivity analysis was performed to address these uncertainties because the potential inclusion of such revised data might result in significant differences in estimated fatalities. The results of this sensitivity analysis are presented in this section.

H.4.1 Approach Taken for the Sensitivity Analysis

In performing such a sensitivity analysis, two approaches can be taken. In the first, the estimates of potential fatalities obtained in the baseline cases described above could be recomputed by using the same plume geometries as for the baseline cases. The potentially affected population would then be subject to increased fatalities in proportion to the assumed increase in sensitivity for infants, children, and the elderly. This approach has the advantage that its results can be directly compared with the estimates of potential fatalities in Table H.1 because the same plumes and populations at risk would be considered. It has the disadvantage that any sensitive populations living outside of the baseline no-deaths plume contour would not be included in the revised estimates of potential fatalities .

In the second approach, the boundary of the lethal plume could be expanded downwind to a new distance to encompass the population that is potentially related to an increased sensitivity. This approach would present problems with predicting plume geometries and boundaries at distances larger than the already sizeable downwind lethal hazard distances for the accident scenarios presented in Table H.1. Furthermore, the D2PCw calculations for the plume geometries are only accurate to within ±50% of the downwind distance. This second approach also has the disadvantage that it is not directly comparable to the baseline estimates of potential fatalities, because expanded plume boundaries are required and larger populations at risk would be involved. For these reasons, the first approach was adopted in the sensitivity analysis described in this appendix.

H.4.1.1 Defining the Sensitive Population

Three age classes were included in the sensitivity analysis: infants, children, and the elderly. Infants are defined as those individuals under the age of 5; children are defined as those more than 5 but less than 15 years old; and the elderly are defined as those persons older than 65 years. Members of the total population who were neither infants, children, nor the elderly were assumed to respond to mustard agent exposure as healthy adult males. Table H.3 reports these proportions, as well as those for the counties within 30 km (19 miles) of PCD.

In the sensitivity analysis, it has been assumed that the geographical distribution of infants, children, and the elderly is the same in the region around PCD as in the general population. The statistics for the population of Pueblo County were taken as representative of the total population because Pueblo County has the greatest percentage of “sensitive” population among the counties immediately surrounding PCD. Therefore, 36.4% of the total population was assumed to be sensitive to mustard agent exposure, while 63.6% was assumed to respond as healthy adult males.

H.4.1.2 Bounding the Sensitivity to Dose-Response

To calculate the effects of the sensitivity of the population to chemical agent exposure, it was assumed that each of the three sensitive groups would have higher rates of death than the rates for the nonsensitive population. The argument has been made (V. Houk, Center for Environmental Health, Department of Health and Human Services, Atlanta, Ga., letter to D. Nydam, Office of the Program Manager for Chemical Demilitarization, Aberdeen Proving

Table H.3. Sensitive population by age distribution around the Pueblo Chemical Depot in Colorado

County	Sensitive population (%) by age groups: less than 5 years old	5 to 14 years old	more than 65 years old	Total	Remaining population (%)
Crowley	4.4	10.7	10.8	25.9	74.1
El Paso	7.6	15.6	8.7	31.9	68.1
Pueblo	6.1	14.5	15.2	36.4	63.6
State of Colorado	6.9	14.4	9.7	31.0	69.0
Entire United States	6.8	14.6	12.4	33.8	66.2

Sources: U.S. Bureau of the Census, *2000 Census; Table DP-1, Profiles of General Demographic Characteristics,* Washington, D.C.; on-line data accessed June 12, 2001, at URL http://www.census.gov/prod/cen2000.

Ground, Md., June 1987) that infants, children, or the elderly might experience fatalities when exposed to chemical agent concentrations almost 80% lower than the no-deaths dose for healthy adult males. It was assumed that those individuals sensitive to a dose equal to 20% of the no-deaths dose for healthy adult males would die at a rate five times greater than the fatality rate for healthy adult males. This assumed fatality rate would be limited only by the size of the sensitive population, such that no more than 100% of that population could be killed.

To bracket the uncertainty in the dose response of the potentially sensitive populations, the sensitivity analysis included three separate downscaled doses: one-half of the no-deaths dose (or ND/2), one-fifth (or ND/5), and one-tenth (or ND/10). These values were used to increase the assumed fatality rate of the affected population by factors of 2, 5, and 10, respectively.

H.4.1.3 Recomputing Estimates of Potential Fatalities

Fatality multipliers for the three zones of each plume are presented in Table H.4. The fatality multipliers for the potentially sensitive population (as shown in Table H.3) were generated as the mathematical product of the increased sensitivity (factors of 2, 5, and 10) and the fatality multiplier for the reference case (i.e., healthy adult males); however, this multiplier could obviously never be larger than 100%.

In computing revised estimates of potential fatalities among the sensitive population, the fatality multipliers within each zone of the plume boundary as taken from Table H.4 were applied to the population percentages reported in Table H.3 for Pueblo County. The number of potential fatalities in the balance of the population (i.e., those who are neither infants, children, nor the elderly) was computed using the fatality multipliers for the reference case.

Table H.4. Fatality multipliers for sensitive populations

Boundary of dose contour within airborne plume[a]	Reference case[b] (ND/1[c])	Scaled no-deaths dose[c] ND/2	ND/5	ND/10
Release point out to 50% lethal dose	0.75	1.00	1.00	1.00
50% lethal dose out to 1% lethal dose	0.25	0.50	1.00	1.00
1% lethal dose out to no-deaths distance	0.005	0.01	0.025	0.05

[a]See Fig. H.1.
[b]See Sect. H.4.
[c]ND = "No-deaths" dose for healthy adult males.

H.4.2 Discussion of Sensitivity Analysis Results

The sensitivity analysis fatality estimates for PCD are presented in Table H.5. This table shows that the fatalities for sensitive populations (i.e., those who might be expected to die from one-tenth the healthy adult male dose) would lead to about 2.1 times the reference-case number of potential fatalities for those accidents occurring under "worst case" meteorological conditions. The results of a similar sensitivity analysis with similar findings is reported in the ACWA Draft EIS (ACWA 2001). The ACWA Draft EIS concludes that the estimates of potential fatalities could be 2.5 times higher when the potentially sensitive population is taken into account.

One result of the sensitivity analysis stands out. The estimated potential maximum fatalities based upon the ND/10 assumptions are essentially the same as those that use the ND/5 assumptions; however, this would be expected from the use of the numerical multipliers in Table H.4. This result indicates that ND/5 dose proposed in Sect. H.4.1.2 represents a reasonable bracketing of differential dose-response sensitivity. However, it should be noted that this result depends in part upon the distribution of the sensitive population around the site, and in part upon the assumed sensitivity (as expressed in fatality rates) of that population to the downscaled dose-response values.

Also, consideration of the potentially sensitive populations could increase the estimates of potential maximum fatalities by as much as 100% above the baseline estimates for the daytime meteorological conditions. However, this increase must be evaluated in light of other uncertainties in the fatality estimation process. For example, the atmospheric dispersion model computes plume geometries that are accurate to within only ±50% of the downwind distance. The resulting plume shapes could therefore cover areas that are approximately 40 to 250% the size of the plume area for the reference case. The potentially affected population in these different areas would also be expected to be proportional to the area. Thus, the uncertainty in the fatality estimates that results from different sensitivities in the population appears to be equal to or less than other sources identified in Sect. H.3.2.

Table H.5. Estimates of potential fatalities, assuming greater sensitivity for infants, children, and the elderly among the residential population surrounding the Pueblo Chemical Depot

Hypothetical Accidents[a]	Potential fatalities among those sensitive to various dose levels[b]			
	Reference case	ND/2	ND/5	ND/10
	Conservative most likely meteorological conditions			
Aircraft crash into storage igloo (5 km)	2	2	3	3
Earthquake at processing building (4 km)	0	0	0	0
	Worst-case meteorological conditions			
Aircraft crash into storage igloo (30 km)	290	390	600	610
Earthquake at processing building (9 km)	2	2	3	3

[a]See Table H.1 for definitions.
[b]Fatality estimates are rounded. ND/2, ND/5, and ND/10 are one-half, one-fifth, and one-tenth, respectively, of the no-deaths dose for healthy adult males (baseline) (see Sect. H.4.1.2).

H.6 FINDINGS AND CONCLUSIONS

Hypothetical accidents that could occur to the storage igloos at PCD include aircraft crashes and earthquakes with an extremely low probability of occurrence. Nevertheless, for the purpose of the bounding the extent of potential environmental impacts in this FEIS, the worst-case storage accident at PCD would have an associated downwind lethal hazard distance (i.e., a no-deaths distance) of up to 30 km (19 miles) under the type of worst-case meteorological conditions usually associated with nighttime hours. This event would have the potential of creating up to 290 fatalities among the residential population around PCD (see Table H.1). If this event were to occur under the type of meteorological conditions usually associated with daylight hours, the downwind no-deaths distance would be 5 km (3 miles), and the number of potential fatalities would be only about 2.

Potential accidents associated with the destruction of munitions would be significantly smaller than the storage accident described in the preceding paragraph. However, the “worst-case” storage accident is used in this EIS to bound the magnitude and spatial extent of the potential impacts to human health and the environment.

Non-Incineration (i.e., ACWA) Technologies. The accident scenario of an aircraft crash into the CHB while processing 4.2-inch mortar rounds was estimated in the ACWA Draft EIS to result in a downwind no-deaths distance of about 9 km (5 miles) under worst-case meteorological conditions. The corresponding number of potential fatalities among the general public was estimated by the ACWA staff to be about 2. If such an accident were to occur under daytime meteorological conditions, there would be no potential fatalities among the general public (see Table H.3).

Incineration (i.e., PMCD) Technologies. The accident scenario of an earthquake affecting the incineration facility while processing 4.2-inch mortar rounds is estimated in this appendix to result in a downwind no-deaths distance of about 9 km (5 miles) under worst-case meteorological conditions. The corresponding number of potential fatalities among the general public is estimated to be only about 2. If such an accident were to occur under daytime meteorological conditions, there would be no potential fatalities among the general public (see Table H.3).

H.6 REFERENCES

ACS (Applied Computing Systems) 2000. *U.S. Army Emergency Management Information System (EMIS*), Ver. 3.1, Build 20, prepared for U.S. Army SBCCOM, Aberdeen Proving Ground, Md., by Applied Computing Systems, Inc., Los Alamos, New Mexico, March.

ACWA (Assembled Chemical Weapons Assessment) 2001. *Draft Environmental Impact Statement for Follow-on Tests Including Design, Construction and Operations of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites*, Program Manager for Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., May.

CSEPP (Chemical Stockpile Emergency Preparedness Program, Accident Planning Base Review Group) 1998. *Emergency Response Concept Plan for the Chemical Stockpile Emergency Preparedness Program, Rev. 1, Vol. 2: Emergency Planning Guide for the Blue Grass Chemical Activity CSEPP Site*, ANL/DIS/TM-49, Argonne National Laboratory, Argonne, IL, March.

Pasquill, F. 1961. “The Estimation of the Dispersion of Windborne Material,” *The Meteorological Magazine* 90, 33–49.

SAIC (Science Applications International Corporation) 1996. *Pueblo Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment*, prepared for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., by SAIC, Abingdon, Md., November.

SAIC (Science Applications International Corporation) 1997. Letter to M. Myirski, Office of the Program Manager for Chemical Stockpile Emergency Preparedness, Edgewood, Md., *Accident Planning Base Tables for Pine Bluff and Pueblo*, LBR-004-97, from L. Robbins and M. Ray, SAIC, Abingdon, Md., May 1.

USANCA (U.S. Army Nuclear and Chemical Agency) 1994. Memorandum for Commander, U.S. Army Chemical Materiel Destruction Agency, *Dose Response Data for the Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment*, from I. Goodheer, Administrative Officer, USANCA, Springfield, Va., June 13.

U.S. Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1–3, Program Executive Officer–Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

U.S. Department of Commerce 2001. *2000 Census of Population*, SF1 Data Files (on CD-ROM), Bureau of the Census, Government Printing Office, Washington, D.C.

Whitacre, G. C., et al. 1986. *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, U.S. Army Chemical Research and Development Center, Aberdeen Proving Ground, Md.

APPENDIX I

PROJECTED ATMOSPHERIC EMISSIONS FROM CHEMICAL MUNITIONS DESTRUCTION FACILITIES AT PUEBLO CHEMICAL DEPOT

I.1 INTRODUCTION

This appendix provides the best available estimates of the toxic air pollutants potentially emitted to the atmosphere from the PMCD's incineration technologies and the ACWA's neutralization technologies. Tables I.1 through I.5 display the data for the incineration technologies, while Tables I.6 and I.7 display the data for the neutralization technologies.

The incineration data were obtained during four trial burns at the Army's JACADS facility. Full trays of undrained 4.2-inch mortars (i.e., a total of 43,617 rounds) filled with liquid (i.e., unfrozen) mustard agent were successfully processed in the metal parts furnace (MPF) at JACADS. The data for 4.2-inch mortar rounds in Tables I.1 through I.5 were obtained from the averages of the emissions measured during the four trial burns. The data for the 105-mm projectiles and the 155-mm projectiles were obtained from extrapolation of the 4.2-inch mortar data. The extrapolation was based upon the anticipated daily feed rate of mustard agent for each munition type at the Pueblo Chemical Depot (PCD). Because most of the compounds sampled for in the stack gases were not detected (or were detected at concentrations at or below the applicable detection limits), most of the numerical entries in Tables I.1 through I.5 represent the detection limits for the listed compounds. The numerical entries, therefore, represent an upper bound on the quantities of air pollutants that would be expected to be emitted from an incineration facility at PCD.

The neutralization data were obtained from the ACWA Draft EIS (ACWA 2001). Table I.6 displays the data for a neutralization/biotreatment facility, and Table I.7 displays the data for a neutralization/SCWO facility. The data in these tables are largely based on theoretical calculations. The ACWA calculations in Table I.7 assume that organic substances for all neutralization/SCWO effluents would filtered from the stack emissions by a series of six carbon filters, each having a removal efficiency of 95%. The data in Table I.6 show both the "treated" and "untreated" biotreatment vent emissions.

I.2 REFERENCE

ACWA (Assembled Chemical Weapons Assessment) 2001. *Draft Environmental Impact Statement for Follow-on Tests Including Design, Construction and Operations of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites*, Program Manager for Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., May.

Table I.1. Projected metals emissions from the metal parts furnace of an incineration facility at the Pueblo Chemical Depot.

Compound		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (μg/dscf)	Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (g/sec)	Estimated Emissions for 105-mm Projectiles (g/sec)	Estimated Emissions for 155-mm Projectiles (g/sec)
Aluminum		5.616	4.260×10^{-4}	2.053×10^{-4}	4.002×10^{-4}
Antimony	*	0.006	4.680×10^{-7}	2.255×10^{-7}	4.680×10^{-7}
Arsenic		0.022	1.640×10^{-6}	7.902×10^{-7}	1.640×10^{-6}
Barium	*	0.445	3.370×10^{-5}	1.624×10^{-5}	3.370×10^{-5}
Beryllium	*	0.004	3.330×10^{-7}	1.604×10^{-7}	3.330×10^{-7}
Boron		3.23	2.240×10^{-4}	1.079×10^{-4}	2.240×10^{-4}
Cadminum	*	0.541	4.020×10^{-5}	1.937×10^{-5}	4.020×10^{-5}
Chromium	*	0.021	1.540×10^{-6}	7.420×10^{-7}	1.540×10^{-6}
Cobalt	*	0.078	5.490×10^{-6}	2.645×10^{-6}	5.490×10^{-6}
Copper	*	0.066	4.900×10^{-6}	2.361×10^{-6}	4.900×10^{-6}
Lead		0.127	9.540×10^{-6}	4.597×10^{-6}	9.540×10^{-6}
Manganese		1.246	8.850×10^{-5}	4.264×10^{-5}	8.850×10^{-5}
Mercury	*	2.88	2.250×10^{-4}	1.084×10^{-4}	2.250×10^{-4}
Nickel	*	0.147	1.090×10^{-5}	5.252×10^{-6}	1.090×10^{-5}
Phosphorous	*	2.406	1.770×10^{-4}	8.528×10^{-5}	1.770×10^{-4}
Selenium	*	0.005	3.590×10^{-7}	1.730×10^{-7}	3.590×10^{-7}
Silver	*	0.061	4.520×10^{-6}	2.178×10^{-6}	4.520×10^{-6}
Tin	*	1.108	8.540×10^{-5}	4.115×10^{-5}	8.540×10^{-5}
Vandium	*	0.023	1.710×10^{-6}	8.239×10^{-7}	1.710×10^{-6}
Thalium	*	0.002	1.480×10^{-7}	7.131×10^{-8}	1.480×10^{-7}
Zinc		2.16	1.630×10^{-4}	7.854×10^{-5}	1.630×10^{-4}
Total Metals		20.194	1.504×10^{-3}	7.248×10^{-3}	1.479×10^{-3}

Note 1: An asterisk (*) following the entry indicates that the named metal was possibly detected during the trial burns, but at a concentration at or below the detection limit. The numerical entry therefore represents the applicable detection limit for that metal.

Note 2: The numerical data entries for the 105-mm and 155-mm projectiles have been scaled from the entries for the 4.2-in mortar rounds. The scaling was done on the basis of the anticipated daily feed rate of agent HD for each type of munition.

Table I.2. Projected dioxin and furan emissions from the metal parts furnace of an incineration facility at the Pueblo Chemical Depot.

		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars		Estimated Emissions for 105-mm Projectiles	Estimated Emissions for 155-mm Projectiles
Compound		**(μg/dscf)**	**(g/sec)**	**(g/sec)**	**(g/sec)**
2,3,7,8-TCDD	*	2.766	4.410×10^{-12}	2.125×10^{-12}	4.143×10^{-12}
Total TCDD	*	18.523	2.950×10^{-11}	1.421×10^{-11}	2.771×10^{-11}
1,2,3,7,8-PeCDD	*	4.813	7.710×10^{-12}	3.715×10^{-12}	7.243×10^{-12}
Total PeCDD	*	7.924	1.260×10^{-11}	6.071×10^{-12}	1.184×10^{-11}
1,2,3,4,7,8-HxCDD	*	5.244	8.370×10^{-12}	4.033×10^{-12}	7.863×10^{-12}
1,2,3;6,7,8-HxCDD	*	4.055	6.480×10^{-12}	3.122×10^{-12}	6.087×10^{-12}
1,2,3,7,8,9-HxCDD	*	4.323	6.910×10^{-12}	3.329×10^{-12}	6.491×10^{-12}
Total HxCDD	*	6.556	1.060×10^{-11}	5.107×10^{-12}	9.958×10^{-12}
1,2,3,4,6,7,8-HpCDD	*	5.912	9.480×10^{-12}	4.568×10^{-12}	8.906×10^{-12}
Total HpCDD	*	5.912	9.480×10^{-12}	4.568×10^{-12}	8.906×10^{-12}
OCDD	*	17.035	2.720×10^{-11}	1.311×10^{-11}	2.555×10^{-11}
2,3,7,8-TCDF	*	3.538	5.580×10^{-12}	2.689×10^{-12}	5.242×10^{-12}
Total TCDF	*	168.908	2.720×10^{-10}	1.311×10^{-10}	2.555×10^{-10}
1,2,3,7,8-PeCDF	*	5.877	9.390×10^{-12}	4.524×10^{-12}	8.821×10^{-12}
2,3,4,7,8-PeCDF	*	6.033	9.640×10^{-12}	4.645×10^{-12}	9.056×10^{-12}
Total PeCDF	*	28.554	4.670×10^{-11}	2.250×10^{-11}	4.387×10^{-11}
1,2,3,4,7,8-HxCDF	*	5.197	8.380×10^{-12}	4.038×10^{-12}	7.872×10^{-12}
1,2,3,6,7,8-HxCDF	*	3.29	5.330×10^{-12}	2.568×10^{-12}	5.007×10^{-12}
2,3,4,6,7,8-HxCDF	*	1.999	3.170×10^{-12}	1.527×10^{-12}	2.978×10^{-12}
1,2,3,7,8,9-HxCDF	*	2.2	3.500×10^{-12}	1.686×10^{-12}	3.288×10^{-12}
Total HxCDF	*	5.638	9.110×10^{-12}	4.389×10^{-12}	8.558×10^{-12}
1,2,3,4,6,7,8-HpCDF	*	5.457	8.690×10^{-12}	4.187×10^{-12}	8.163×10^{-12}
1,2,3,4,7,8,9-HpCDF	*	3.921	6.240×10^{-12}	3.007×10^{-12}	5.862×10^{-12}
Total HpCDF	*	5.908	9.430×10^{-12}	4.544×10^{-12}	8.859×10^{-12}
OCDF	*	18.914	3.000×10^{-11}	1.445×10^{-11}	2.818×10^{-11}
Total Toxicity Equivalent		11.657	1.860×10^{-11}	8.962×10^{-12}	1.747×10^{-11}

Note 1: An asterisk (*) following the entry indicates that the named dioxin or furan was possibly detected during the trial burns, but at a concentration at or below the detection limit. The numerical entry therefore represents the applicable detection limit for that compound.

Note 2: The numerical data entries for the 105-mm and 155-mm projectiles have been scaled from the entries for the 4.2-in mortar rounds. The scaling was done on the basis of the anticipated daily feed rate of agent HD for each type of munition.

Table I.3. Projected polychlorinated biphenyls (pcbs) emissions from the metal parts furnace of an incineration facility at the Pueblo Chemical Depot.

Compound		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (µg/dscf)	Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (g/sec)	Estimated Emissions for 105-mm Projectiles (g/sec)	Estimated Emissions for 155-mm Projectiles (g/sec)
Total MonoCB	*	1.700	2.700×10^{-9}	1.30×10^{-9}	2.536×10^{-9}
Total DiCB	*	2.001	3.170×10^{-9}	1.53×10^{-9}	2.978×10^{-9}
Total TriCB	*	3.625	5.700×10^{-9}	2.75×10^{-9}	5.355×10^{-9}
3,3',4,4'-TetraCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
Total TetraCB	*	2.051	3.250×10^{-9}	1.57×10^{-9}	3.053×10^{-9}
2,3',4,4',5-PentaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
2,3,3',4,4'-PentaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
2',3,4,4',5-PentaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
3,3',4,4',5-PentaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
Total PentaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
2,3,3',4,4',5-HexaCB	*	1.952	3.090×10^{-9}	1.49×10^{-9}	2.903×10^{-9}
2,3,3',4,4',5'-HexaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
2,3',4,4',5,5'-HexaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
3,3',4,4',5,5'-HexaCB		1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
Total HexaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
2,3,3',4,4',5,5'-HeptaCB	*	1.700	2.700×10^{-9}	1.30×10^{-9}	2.536×10^{-9}
2,2',3,4,4',5,5'-HeptaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
2,2',3,3',4,4',5-HeptaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
Total HeptaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
Total OctaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
Total NonaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
DecaCB	*	1.685	2.680×10^{-9}	1.29×10^{-9}	2.518×10^{-9}
Total Toxicity Equivalent		0.136	3.020×10^{-9}	1.46×10^{-9}	2.837×10^{-9}

Note 1: An asterisk (*) following the entry indicates that the named PCB was possibly detected during the trial burns, but at a concentration at or below the detection limit. The numerical entry therefore represents the applicable detection limit for that compound.

Note 2: The numerical data entries for the 105-mm and 155-mm projectiles have been scaled from the entries for the 4.2-in mortar rounds. The scaling was done on the basis of the anticipated daily feed rate of agent HD for each type of munition.

Table I.4. Projected volatile organic compounds (VOCs) emissions from the metal parts furnace of an incineration facility at the Pueblo Chemical Depot.

		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars		Estimated Emissions for 105-mm Projectiles	Estimated Emissions for 155-mm Projectiles
Compound		**(µg/dscf)**	**(g/sec)**	**(g/sec)**	**(g/sec)**
Acetone	*	61149	1.04×10^{-3}	5.01×10^{-4}	9.770×10^{-4}
Benzene	*	26036	4.43×10^{-4}	2.13×10^{-4}	4.162×10^{-4}
Bromodichloro-methane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
Vinyl bromide	*	15451	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
Bromoform	*	7763	1.32×10^{-4}	6.36×10^{-5}	1.240×10^{-4}
Bromomethane (methyl bromide)	*	15451	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
2-Butanone (MEK)	*	33322	6.65×10^{-4}	3.20×10^{-4}	6.247×10^{-4}
1,3-Butadiene	*	15451	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
Carbon Disulfide	*	8333	1.14×10^{-4}	5.49×10^{-5}	1.071×10^{-4}
Carbon Tetrachloride	*	9413	1.59×10^{-4}	7.66×10^{-5}	1.494×10^{-4}
Chlorobenzene	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
Chlorodibromo-methane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
Chloroethane	*	15451	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
Chloroform	*	8841	5.49×10^{-6}	2.65×10^{-6}	5.157×10^{-6}
Chloromethane	*	15717	4.90×10^{-6}	2.36×10^{-6}	4.603×10^{-6}
2-Chloropropane	*	15451	9.54×10^{-6}	4.60×10^{-6}	8.962×10^{-6}
1,2-Dibromo-ethane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
Dibromo-methane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,4-Dichloro-2-butene	*	15451	1.09×10^{-5}	5.25×10^{-6}	1.024×10^{-5}
dichlorodiflouro-methane	*	12878	1.77×10^{-4}	8.53×10^{-5}	1.663×10^{-4}
1,1-dichloro-ethane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,2-dichloro-ethane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,1-dichloro-ethane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
trans-1,2-dichloro-ethene	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,2-dichloro-propane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
cis-1,3-dichloro-propene	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
trans-1,3-Dichloropropene	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
ethylbenzene	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
n-Hexane	*	15451	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
2-hexanone	*	30903	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
Iodomethane	*	15451	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
Methylene Chloride	*	50123	8.49×10^{-4}	4.09×10^{-4}	7.976×10^{-4}

Table I.4 (continued)

Compound		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (μg/dscf)	(g/sec)	Estimated Emissions for 105-mm Projectiles (g/sec)	Estimated Emissions for 155-mm Projectiles (g/sec)
4-methly-2-pentanone	*	30903	5.24×10^{-4}	2.52×10^{-4}	4.922×10^{-4}
2-Propanol	*	133149	2.24×10^{-3}	1.08×10^{-3}	2.104×10^{-3}
Styrene	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,1,1,2-tetra-chloroethane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,1,2,2-tetra-chloroethane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
Tetrachloroethene (PCE)	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,1,2-trichloro-triflouroethane	*	15451	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
Toluene	*	8678	1.47×10^{-4}	7.08×10^{-5}	1.381×10^{-4}
1,1,1-trichloro-ethane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,1,2-trichloro-ethane	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
Trichloroethene (TCE)	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
1,2,3-Trichloro-propane*	*	7726	1.31×10^{-4}	6.31×10^{-5}	1.231×10^{-4}
Trichloro-fluoromethane (Freon 11)	*	151734	2.57×10^{-3}	1.24×10^{-3}	2.414×10^{-3}
Vinyl acetate	*	15451	2.62×10^{-4}	1.26×10^{-4}	2.461×10^{-4}
Vinyl Chloride	*	12878	2.19×10^{-4}	1.06×10^{-4}	2.057×10^{-4}
xylenes	*	7836	1.33×10^{-4}	6.41×10^{-5}	1.249×10^{-4}

Note 1: An asterisk (*) following the entry indicates that the named VOC was possibly detected during the trial burns, but at a concentration at or below the detection limit. The numerical entry therefore represents the applicable detection limit for that compound.

Note 2: The numerical data entries for the 105-mm and 155-mm projectiles have been scaled from the entries for the 4.2-in mortar rounds. The scaling was done on the basis of the anticipated daily feed rate of agent HD for each type of munition.

Table I.5. Projected semivolatile organic compounds emissions for the metal parts furnace of an incineration facility at the Pueblo Chemical Depot.

		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars		Estimated Emissions for 105-mm Projectiles	Estimated Emissions for 155-mm Projectiles
Compound		**(μg/dscf)**	**(g/sec)**	**(g/sec)**	**(g/sec)**
Acenaphthene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Acenapthylene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Acetophenone	*	0.195	1.200×10^{-4}	5.78×10^{-5}	1.127×10^{-4}
2-Acetylamino-fluorene	*	1.891	1.160×10^{-3}	5.59×10^{-4}	1.090×10^{-3}
4-Aminobiphenyl	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
3-Amino-9-ethy-carbazole		N.D.	N.D.	N.D.	N.D.
Aniline	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Anthracene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Aramite	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzidine	*	1.891	1.160×10^{-3}	5.59×10^{-4}	1.090×10^{-3}
Benzoic acid	*	2.386	1.460×10^{-3}	7.03×10^{-4}	1.372×10^{-3}
Benzo (a) anthracene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzo (b) fluoranthrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzo (j) fluoranthrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzo (k) fluoranthrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzo (g,h,I) perylene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzo (a) pyrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzo (e) pyrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzyl alcohol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzaldehyde	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Benzenethiol		N.D.	N.D.	N.D.	N.D.
Biphenyl	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
4-Bromophgenyl phenyl ether	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Butyl benzyl phthalate	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2-sec-Butyl-4,6-dinitro-phenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
4-Chloroaniline	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
bis(2-Chloro-ethyl)-methane	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
bis(2-Chloroethyl) ether	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2,2'-Oxybis (1-chloropropane)	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Chlorobenzilate	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}

Table I.5 (continued)

Compound		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (µg/dscf)	(g/sec)	Estimated Emissions for 105-mm Projectiles (g/sec)	Estimated Emissions for 155-mm Projectiles (g/sec)
4-Chloro-3-methylphenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1-Chloro-naphthalene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2-Chloro-naphthalene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2-Chlorophenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
4-Chlorophenyl phenyl ether	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Chrysene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
4,4'-DDE		N.D.	N.D.	N.D.	N.D.
Diallate	*	0.378	2.320×10^{-4}	1.12×10^{-4}	2.179×10^{-4}
Dibenz(a,h) anthracene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Dibenz(a,j) acridine		N.D.	N.D.	N.D.	N.D.
Dibenzofuran	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1,2-Dibromo-3-chloropropane		N.D.	N.D.	N.D.	N.D.
Di-n-butyl phthalate	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1,2-Dichloro-benzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1,3-Dichloro-benzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1,4-Dichloro-benzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
3,3'-Dichloro-benzidine	*	0.378	2.320×10^{-4}	1.12×10^{-4}	2.179×10^{-4}
2,4-Dichloro-phenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2,6-Dichloro-phenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Diethyl phthalate	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Dihydrosafrole		N.D.	N.D.	N.D.	N.D.
p-Dimethylamino-azobenzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
7,12-Dimethyl-benz(a)-anthracene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
3,3'-Dimethyl-benzidine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
a,a-Dimethyl-phenethyl-amine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2,4-Dimethyl-phenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Dimethyl phthalate	*	0.451	2.770×10^{-4}	1.33×10^{-4}	2.602×10^{-4}

Table I.5 (continued)

Compound		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (μg/dscf)	(g/sec)	Estimated Emissions for 105-mm Projectiles (g/sec)	Estimated Emissions for 155-mm Projectiles (g/sec)
1,3-Dinitro-benzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
4,6-Dinitro-2-methylphenol	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
2,4-Dinitrophenol	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
2,4-Dinitrotoluene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2,6-Dinitrotoluene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Dioxathion		N.D.	N.D.	N.D.	N.D.
Di-n-octyl phthalate	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1,3-Diphenyl-hydrazine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Diphenylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
bis(2-Ethyl-hexyl)-phthalate	*	0.225	1.390×10^{-4}	6.70×10^{-5}	1.306×10^{-4}
Ethyl methane-sulfonate	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Ethyl parathion		N.D.	N.D.	N.D.	N.D.
Fluoranthene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Flourene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Heptachlor		N.D.	N.D.	N.D.	N.D.
Hexachloro-benzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Hexachloro-butadiene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Hexachlorocyclo-pentadiene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Hexachloroethane	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Hexachlorophene		N.D.	N.D.	N.D.	N.D.
Hexachloro-propene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Indeno(1,2,3-cd) pyrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Isophorone	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Isosafrole	*	0.378	2.320×10^{-4}	1.12×10^{-4}	2.179×10^{-4}
Methapyrilene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Methoxychlor		N.D.	N.D.	N.D.	N.D.
3-Methylchol-anthrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Methyl methane-sulfonate	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2-Methyl-naphalene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2-Methyl-5-nitroaniline		N.D.	N.D.	N.D.	N.D.
2-Methylphenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
3/4-Methyl-phenone	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}

Table I.5 (continued)

Compound		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (µg/dscf)	(g/sec)	Estimated Emissions for 105-mm Projectiles (g/sec)	Estimated Emissions for 155-mm Projectiles (g/sec)
Naphthalene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1,4-Naphtho-quinone	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1-Napthylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2-Napthylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
5-Nitro-acenaphthene		N.D.	N.D.	N.D.	N.D.
2-Nitroaniline	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
3-Nitroaniline	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
4-Nitroaniline	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
Nitrobenzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2-Nitrophenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
4-Nitrophenol	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
4-Nitroquinoline-1-oxide	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N,N'-Diisopropyl-carbodiimide		N.D.	N.D.	N.D.	N.D.
N-Nitroso-di-n-butylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N-Nitrosodi-ethylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N-Nitrosodi-methylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N-Nitrosodi-phenylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N-Nitroso-di-n-propylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N-Nitrosomethyl-ethylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N-Nitro-somorpholine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N-Nitro-sopiperidine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
N-Nitro-sopyrrolidine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
5-Nitro-o-toluidine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Pentachloro-benzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Pentachloro-ethane	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Pentachloro-nitrobenzene (PCNB)	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
Pentachloro-phenol	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
Phenacetin	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Phenanthrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}

Table I.5 (continued)

Compound		Average Emissions for JACADS Trial Burn, 4.2-inch Mortars (µg/dscf)	(g/sec)	Estimated Emissions for 105-mm Projectiles (g/sec)	Estimated Emissions for 155-mm Projectiles (g/sec)
Phenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
p-Phenylene-diamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Phosphonic Acid, methyl-, bis (1-methylethyl) ester		N.D.	N.D.	N.D.	N.D.
2-Picoline	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Pronamide	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Pyrene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
Quinoline		N.D.	N.D.	N.D.	N.D.
Pyridine	*	0.378	2.320×10^{-4}	1.12×10^{-4}	2.179×10^{-4}
Safrole	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1,2,4,5-Tetra-chloro-benzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2,3,4,6-Tetra-chlorophenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
p-Toluidne	*	0.946	5.810×10^{-4}	2.80×10^{-4}	5.458×10^{-4}
2-Toluidine		N.D.	N.D.	N.D.	N.D.
Tributylamine	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
1,2,4-Trichloro-benzene		N.D.	N.D.	N.D.	N.D.
2,4,5-Trichloro-phenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
2,4,6-Trichloro-phenol	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}
0,0,0-Triethyl-phosphoro-thioate	*	1.891	1.160×10^{-3}	5.59×10^{-4}	1.090×10^{-3}
1,3,5-Trinitro-benzene	*	0.189	1.160×10^{-4}	5.59×10^{-5}	1.090×10^{-4}

Note 1: An asterisk (*) following the entry indicates that the named compound was possibly detected during the trial burns, but at a concentration at or below the detection limit. The numerical entry therefore represents the applicable detection limit for that compound. An entry of "N.D." indicates that the named compound was not detected at any concentration during the trial burns..

Note 2: The numerical data entries for the 105-mm and 155-mm projectiles have been scaled from the entries for the 4.2-in mortar rounds. The scaling was done on the basis of the anticipated daily feed rate of agent HD for each type of munition.

Table I.6. Estimated toxic air pollutant emissions from a neutralization/biotreatment facility at the Pueblo Chemical Depot.

	Emissions (µg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
1,1,1-Trichloroethane	-	-	-	-	1.05×10^{-10}
1,2,3,4,6,7,8,9-OCDD	-	-	1.58×10^{-9}	1.58×10^{-2}	3.15×10^{-13}
1,2,3,4,6,7,8,9-OCDF	-	-	3.15×10^{-10}	3.68×10^{-3}	7.36×10^{-13}
1,2,3,4,6,7,8-HpCDD	-	-	3.15×10^{-10}	3.68×10^{-3}	6.31×10^{-13}
1,2,3,4,6,7,8-HpCDF	-	-	3.68×10^{-10}	4.20×10^{-3}	6.31×10^{-13}
1,2,3,4,7,8,9-HpCDF	-	-	1.05×10^{-10}	1.05×10^{-3}	6.31×10^{-14}
1,2,3,4,7,8-HxCDD	-	-	1.58×10^{-11}	1.58×10^{-4}	6.31×10^{-14}
1,2,3,4,7,8-HxCDF	-	-	1.05×10^{-10}	1.05×10^{-3}	6.31×10^{-13}
1,2,3,6,7,8-HxCDD	-	-	3.15×10^{-11}	3.68×10^{-4}	2.10×10^{-13}
1,2,3,6,7,8-HxCDF	-	-	4.73×10^{-11}	5.25×10^{-4}	3.15×10^{-13}
1,2,3,7,8,9-HxCDD	-	-	5.25×10^{-11}	5.25×10^{-4}	2.10×10^{-13}
1,2,3,7,8,9-HxCDF	-	-	-	-	3.15×10^{-14}
1,2,3,7,8-PeCDD	-	-	1.58×10^{-12}	2.10×10^{-5}	6.31×10^{-14}
1,2,3,7,8-PeCDF	-	-	4.73×10^{-11}	5.25×10^{-4}	1.05×10^{-13}
1,2-Dichloroethane*	-	-	5.25×10^{-7}	3.68×10^{1}	2.10×10^{-5}
1,2-Dichloropropane*	-	-	-	-	3.15×10^{-10}
1,3-Butadiene*	1.08	-	-	-	-
1,4-Dichlorobenzene*	-	-	-	-	3.15×10^{-9}
2,3,4,6,7,8-HxCDF	-	-	4.73×10^{-11}	5.25×10^{-4}	3.15×10^{-13}
2,3,4,7,8-PeCDF	-	-	5.25×10^{-11}	1.05×10^{-3}	4.20×10^{-13}
2,3,7,8-TCDD*	-	-	2.63×10^{-12}	2.63×10^{-5}	-
2,3,7,8-TCDF	-	-	5.25×10^{-11}	1.05×10^{-3}	1.05×10^{-12}
2-Methylnaphthalene	-	8.58×10^{-2}	-	-	-
3/4-Methyl phenol	-	-	-	-	1.05×10^{-9}
3-Methylchloranthrene	-	6.43×10^{-3}	-	-	-
Acenaphthene	3.93×10^{-2}	6.43×10^{-3}	-	-	-
Acenaphthylene	1.40×10^{-1}	6.43×10^{-3}	-	-	-
Acetaldehyde*	2.12×10^{1}	-	1.58×10^{-6}	1.05×10^{2}	-
Acrolein*	2.56	-	-	-	-
Aldehydes	1.94×10^{3}	-	-	-	-
Anthracene	5.18×10^{-2}	8.58×10^{-3}	-	-	-
Arsenic*	-	7.15×10^{-1}	-	-	-
Barium	-	1.57×10^{1}	-	-	-
Benz(a)anthracene	4.65×10^{-2}	6.43×10^{-3}	-	-	-
Benzene*	2.58×10^{1}	7.50	-	-	8.41×10^{-9}
Benzo(a)pyrene	5.21×10^{-3}	4.29×10^{-3}	-	-	-
Benzo(b)fluoranthene	2.75×10^{-3}	6.43×10^{-3}	-	-	-
Benzo(g,h,i)perylene	1.35×10^{-2}	4.29×10^{-3}	-	-	-
Benzo(k)fluoranthene	4.29×10^{-3}	6.43×10^{-3}	-	-	-
Beryllium*	-	4.29×10^{-2}	-	-	-
bis (2-Chloroethyl) ether	-	-	4.20×10^{-7}	2.63×10^{1}	-

TABLE 6.6-1 (Cont.)

	Emissions (μg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
bis (2-Ethylhexyl) phthalate*	-	-	5.25×10^{-7}	3.68×10^{1}	8.41×10^{-9}
Bromomethane*	-	-	1.58×10^{-6}	1.05×10^{2}	2.10×10^{-7}
Butane	-	7.50×10^{3}	-	-	-
Cadmium*	-	3.93	-	-	-
Carbon disulfide*	-	-	-	-	2.10×10^{-7}
Carbon tetrachloride*	-	-	-	-	3.15×10^{-9}
Chlorobenzene*	-	-	-	-	3.15×10^{-7}
Chloroethane*	-	-	-	-	4.20×10^{-9}
Chloroform*	-	-	-	-	5.25×10^{-7}
Chloromethane*	-	-	1.58×10^{-6}	1.05×10^{2}	3.15×10^{-6}
Chromium*	-	5.00	-	-	2.10×10^{-7}
Chrysene	9.78×10^{-3}	6.43×10^{-3}	-	-	-
Cobalt*	-	3.00×10^{-1}	-	-	2.10×10^{-7}
Copper	-	3.04	-	-	-
Dibenzo(a,h)anthracene	-	4.29×10^{-3}	-	-	-
Dibenzofuran*	-	-	-	-	3.15×10^{-9}
Dichlorobenzene*	-	4.29	-	-	-
Diethylphthalate	-	-	5.25×10^{-7}	4.20×10^{1}	-
Dimethylbenz(a)anthracene	1.61×10^{-2}	5.72×10^{-2}	-	-	-
Dimethylphthalate*	-	-	-	-	2.10×10^{-8}
Ethane	-	1.11×10^{4}	-	-	-
Ethyl benzene*	-	-	4.73×10^{-6}	3.15×10^{2}	8.41×10^{-10}
Fluoranthene	2.11×10^{-1}	1.07×10^{-2}	-	-	-
Fluorene	8.09×10^{-1}	1.00×10^{-2}	-	-	-
Formaldehyde*	3.27×10^{1}	2.68×10^{2}	1.05×10^{-5}	1.05×10^{3}	-
Glycol ethers (2-butoxy ethanol)	-	-	4.20×10^{-6}	2.63×10^{2}	-
H (mustard)[e]	-	-	-	-	2.77×10^{2}
Hexane(n)*	-	6.43×10^{3}	-	-	-
Indeno(1,2,3-cd)pyrene	1.04×10^{-2}	6.43×10^{-3}	-	-	-
Lead*	-	1.79	-	-	7.36×10^{-9}
m,p-Xylene*	7.89	-	4.20×10^{-5}	2.63×10^{3}	3.15×10^{-8}
Manganese*	-	1.36	-	-	6.31×10^{-8}
Mercury*	8.35×10^{-3}	9.29×10^{-1}	1.58×10^{-4}	2.10×10^{1}	2.10×10^{-8}
Methyl ethyl ketone*	-	-	-	-	1.05×10^{-5}
Methyl ethyl ketone/butyraldehydes*	-	-	5.25×10^{-7}	3.15×10^{1}	-
Methylene chloride*	-	-	1.05×10^{-5}	1.05×10^{3}	2.10×10^{-8}
Molybdenum	-	3.93	-	-	-
Naphthalene*	2.35	2.18	3.68×10^{-7}	2.63×10^{1}	4.20×10^{-8}
Nickel*	-	7.50	-	-	1.05×10^{-7}
OCDD	-	-	3.15×10^{-10}	3.15×10^{-3}	-
OCDF	-	-	1.05×10^{-10}	1.58×10^{-3}	-
o-Xylene*	-	-	-	-	2.10×10^{-9}

TABLE 6.6-1 (Cont.)

Compound[a]	Emissions (µg/s)[b] Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
Particulates	-	-	-	-	5.25×10^{-4}
Pentane(n)	-	9.29×10^{3}	-	-	-
Phenanthrene	8.14×10^{-1}	6.07×10^{-2}	-	-	-
Phenol*	-	-	1.58×10^{-7}	1.05×10^{1}	5.25×10^{-9}
Phosphorus*	-	-	-	-	2.10×10^{-8}
PAHs	4.65	-	-	-	-
POM (fluorene)	-	-	-	-	3.15×10^{-8}
Propanal (propionaldehyde)*	-	-	5.25×10^{-7}	4.20×10^{1}	-
Propane	-	5.72×10^{-3}	-	-	-
Propylene	7.15×10^{1}	-	-	-	-
Pyrene	1.32×10^{-1}	1.79×10^{-2}	-	-	-
Selenium*	-	8.58×10^{-2}	-	-	2.10×10^{-9}
Styrene*	-	-	-	-	8.41×10^{-13}
Tetrachloroethene*	-	-	-	-	2.10×10^{-10}
Toluene*	1.13×10^{1}	1.21×10^{1}	1.05×10^{-6}	5.25×10^{1}	4.20×10^{-8}
Total HpCDD	-	-	5.25×10^{-10}	5.25×10^{-3}	1.05×10^{-12}
Total HpCDF	-	-	5.25×10^{-10}	5.25×10^{-3}	8.41×10^{-13}
Total HxCDD	-	-	4.20×10^{-10}	4.73×10^{-3}	2.10×10^{-12}
Total HxCDF	-	-	3.68×10^{-10}	4.20×10^{-3}	2.10×10^{-12}
Total PeCDD	-	-	-	-	2.10×10^{-12}
Total PeCDF	-	-	5.25×10^{-10}	5.25×10^{-3}	4.20×10^{-12}
Total TCDD*	-	-	1.58×10^{-11}	1.58×10^{-4}	1.05×10^{-12}
Total TCDF	-	-	2.63×10^{-10}	2.63×10^{-3}	2.10×10^{-8}
Vanadium	-	8.22	-	-	-

[a] Substances designated with an asterisk are listed as HAPs under Title III, Section 112 of the *Clean Air Act.* PAHs = polycyclic aromatic hydrocarbons. POM = polycyclic organic matter. Polychlorinated dioxins/furans are as follows: HpCDD = heptachlorodibenzo-p-dioxin, HpCDF = heptachlorodibenzo-p-furan, HxCDD = hexachlorodibenzo-p-dioxin, HxCDF = hexachlorodibenzo-p-furan, OCDD = octachlorodibenzo-p-dioxin, OCDF = octachlorodibenzo-p-furan, PeCDD = pentachlorodibenzo-p-dioxin, PeCDF = pentachlorodibenzo-p-furan, TCDD = tetrachlorodibenzo-p-dioxin, and TCDF = tetrachlorodibenzo-p-furan.

[b] A hyphen indicates that the compound would not be emitted from this source.

[c] For untreated values, it is assumed that compounds are released directly to the stack after being processed through the catalytic oxidation unit (CatOx). For treated values, it is assumed that after organics pass through the CatOx, they pass through six carbon filters in series, each at 95% efficiency. For treated values, it is assumed that PM passes through two HEPA filters in series, each at 99.97% efficiency.

[d] Filter farm stack emissions are assumed to be treated by using carbon filters to capture organics and by using HEPA filters to capture PM, as in footnote c above.

[e] The after-treatment emission rate from the filter farm stack for the mustard agent is a worst-case estimate; it assumes continuous emissions at the detection limit of 0.006 µg/m^3 during operations (Kimmell et al. 2001). It is assumed that no mustard would be emitted from the immobilized cell bioreactor (ICB) unit; none would be present after neutralization and ICB treatment.

Table I.7. Estimated toxic air pollutant emissions from a neutralization/SCWO facility at the Pueblo Chemical Depot.

	Emissions (µg/s)[b]			
Compound[a]	Diesel Generator	Boiler	SCWO Vent[c]	Filter Farm Stack[d]
1,3-Butadiene*	1.08	-	-	-
2-Methylnaphthalene	-	8.58×10^{-2}	-	-
3-Methylchloranthrene	-	6.43×10^{-3}	-	-
Acenaphthene	3.93×10^{-2}	6.43×10^{-3}	-	-
Acenaphthylene	1.40×10^{-1}	6.43×10^{-3}	-	-
Acetaldehyde*	2.12×10^{1}	-	1.83×10^{-7}	-
Acrolein*	2.56	-	-	-
Aldehydes	1.94×10^{3}	-	-	-
Anthracene	5.18×10^{-2}	8.58×10^{-3}	-	-
Antimony*	-	-	2.50×10^{-7}	-
Arsenic*	-	7.15×10^{-1}	8.64×10^{-8}	-
Barium	-	1.57×10^{1}	-	-
Benz(a)anthracene	4.65×10^{-2}	6.43×10^{-3}	-	-
Benzene*	2.58×10^{1}	7.50	-	-
Benzo(a)pyrene	5.21×10^{-3}	4.29×10^{-3}	-	-
Benzo(b)fluoranthene	2.75×10^{-3}	6.43×10^{-3}	-	-
Benzo(g,h,I)perylene	1.35×10^{-2}	4.29×10^{-3}	-	-
Benzo(k)fluoranthene	4.29×10^{-3}	6.43×10^{-3}	-	
Beryllium*	-	4.29×10^{-2}	1.77×10^{-8}	-
Butane	-	7.50×10^{3}	-	-
Cadmium*	-	3.93	1.77×10^{-8}	-
Chromium*	-	5.00	5.19×10^{-7}	-
Chrysene*	9.78×10^{-3}	6.43×10^{-3}	-	-
Cobalt*	-	3.00×10^{-1}	1.24×10^{-7}	-
Copper	-	3.04	-	-
Dibenzo(a,h)anthracene	1.61×10^{-2}	4.29×10^{-3}	-	-
Dichlorobenzene*	-	4.29	-	-
Dimethylbenz(a)anthracene	-	5.72×10^{-2}	-	-
Ethane	-	1.11×10^{4}	-	-
Ethyl benzene*	-	-	1.71×10^{-6}	-
Fluoranthene	2.11×10^{-1}	1.07×10^{-2}	-	-
Fluorene	8.09×10^{-1}	1.00×10^{-2}	-	-
Formaldehyde*	3.27×10^{1}	2.68×10^{2}	2.32×10^{-7}	-
H (mustard)[d]	-	-	-	2.77×10^{2}
Hexane(n)*	-	6.43×10^{3}	-	-
Indeno(1,2,3-cd)pyrene*	1.04×10^{-2}	6.43×10^{-3}	-	-

TABLE 6.6-2 (Cont.)

	Emissions (µg/s)[b]			
Compound[a]	Diesel Generator	Boiler	SCWO Vent[c]	Filter Farm Stack[d]
Lead*	-	1.79	2.94×10^{-7}	-
m,p-Xylene*	7.89	-	-	-
Manganese*	-	1.36	4.57×10^{-7}	-
Mercury*	8.35×10^{-3}	9.29×10^{-1}	-	-
Methyl ethyl ketone/butyraldehydes*	-	-	5.25×10^{-9}	-
Molybdenum	-	3.93	-	-
m-Xylene*	-	-	1.56×10^{-6}	-
Naphthalene*	2.35	2.18	0.00	-
Nickel*	-	7.50	1.08×10^{-6}	-
Particulates	-	-	7.36×10^{-6}	-
p-Cresol (4-methylphenol)*	-	-	1.32×10^{-7}	-
Pentane(n)	-	9.29×10^{3}	-	-
Phenanthrene	8.14×10^{-1}	6.07×10^{-2}	-	-
Phosphorus	-	-	2.72×10^{-5}	-
PAHs	4.65	-	-	-
Propane	-	5.72×10^{3}	-	-
Propylene	7.15×10^{1}	-	-	-
Pyrene*	1.32×10^{-1}	1.79×10^{-2}	-	-
Selenium*	-	8.58×10^{-2}	8.92×10^{-8}	-
Toluene*	1.13×10^{1}	1.21×10^{1}	-	-
Total HpCDF	-	-	2.46×10^{-16}	-
Total TCDD	-	-	1.84×10^{-12}	-
Vanadium	-	8.22	-	-
Zinc	-	-	-	-

[a] Substances designated with an asterisk are listed as HAPs under Title III, Section 112 of the *Clean Air Act*. PAHs = polycyclic aromatic hydrocarbons. HpCDF = heptachlorodibenzo-p-furan. TCDD = tetrachlorodibenzo-p-dioxin.

[b] A hyphen indicates that the compound was not detected from this source during testing.

[c] For SCWO vent stack emissions, organics are assumed to pass through six carbon filters in series, each at 95% efficiency. PM is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d] The after-treatment emission rate from the filter farm stack for the mustard agent is a worst-case estimate; it assumes emissions at the detection limit during operations (Kimmell et al. 2001). It was assumed that no agent would be emitted from the SCWO stack; none would be present after neutralization and SCWO treatment.

APPENDIX J

SOCIOECONOMICS IMPACT ASSESSMENT METHODS[1]

Socioeconomic analyses assessed the potential impacts from constructing and operating a chemical munitions destruction facility on the population, employment, income, housing, community services, and traffic in an region of influence (ROI) surrounding the site. This ROI includes the area in which site employees live, i.e. Pueblo County. Impacts on agriculture from accidents at the site were assessed for an ROI that includes all counties partially or completely within a 30-mi (50-km) radius of the site (Crowly, El Paso, Lincoln, Otero, and Pueblo Counties).

J.1 IMPACTS ON REGIONAL EMPLOYMENT AND INCOME

The impacts from the destruction facility on regional employment and income were assessed by using regional economic multipliers, together with detailed data on life-cycle project expenditures and schedules for construction and operations. Multipliers capture the indirect (off-site) effects of on-site activities associated with construction and operation of the chemical munitions destruction facility. Multipliers were derived from IMPLAN model input-output economic accounts for the ROI. They include the flow of commodities from producers to industries and institutional consumers. They also include consumption activities by workers and owners of capital and imports from outside the region. The IMPLAN model contains 528 sectors representing industries in agriculture, mining, construction, manufacturing, wholesale and retail trade, utilities, finance, insurance and real estate, and consumer and business services. The model also includes information for each sector on employee compensation; proprietary and property income; personal consumption expenditures; federal, state, and local expenditures; inventory and capital information; and imports and exports.

Data on expenditures associated with the construction and operation of the chemical munitions destruction facility were derived from engineering-cost data provided by the construction and engineering contractors building the facility. These data showed, for both construction and operation, details on individual cost components in terms of labor, materials, any subcontracts, and taxes. The data also provide a detailed breakdown of how specified expenses occur over the life of the project. The data covered both direct expenses (fabrication, installation, certification, testing) and indirect expenses (contractor field expenses, contractor overhead and bond, construction management and project management expenses, architectural and engineering expenses). Cost data for each cost category were assigned to the appropriate years in which specific expenditures occur and then mapped into the relevant Standard Industrial Classification (SIC) codes to be used with multipliers from the IMPLAN model specified for the ROI counties.

---

[1]The material in this appendix has been excerpted from Appendix G of the ACWA EIS. The original material was written by Tim Allison of Argonne National Laboratory.

Information on the expected pattern of procurement within the ROI for the various materials and subcontracts in each cost category was used to calculate impacts so that total procurement expenditures in these two categories could be adjusted. The extent of procurement within the ROI was either determined on the basis of procurement data provided by the engineering and construction contractors or estimated by using proxy data based on ROI employment shares by sector and ROI unemployment rates.

IMPLAN multipliers for each sector in which regional spending occurs and data on expenditures were used to estimate impacts on ROI employment and income. Impacts on employment were described in terms of the total number of jobs created in the region in the peak year of construction and in the first year of operation. The relative impact of the increase in employment in the ROI was calculated by comparing total destruction facility construction employment over the period in which construction occurs with baseline ROI employment forecasts over the same period. Impacts were expressed in terms of the percentage point difference in the average annual employment growth rate with and without project construction. Forecasts were based on data provided by the U.S. Department of Commerce (DOC).

J.2 IMPACTS ON POPULATION

An important factor to consider in assessing the potential impacts from a chemical munitions destruction facility is the number of workers, including their families and children, who would migrate into the ROI, either temporarily or permanently, as a result of the construction and operation of the facility. The capacity of regional labor markets to supply workers in the appropriate occupations required for facility construction and operation in sufficient numbers is closely related to the occupational profile of the ROI and occupational unemployment rates. To estimate the in-migration that would occur to satisfy direct labor requirements, the analysis developed estimates of available labor in each direct labor category that were based on ROI unemployment rates applied to each occupational category. Data on in-migration associated with indirect labor requirements were derived from estimates of available workers in the ROI economy as a whole that would be able to satisfy the demand for labor by industry sectors in which destruction facility spending would initially occur. The national average household size was used to calculate the number of additional family members who would accompany direct and indirect in-migrating workers.

Impacts on population were described in terms of the total number of in-migrants arriving in the region in the peak year of construction and in the first year of operation. The relative impact of the increase in population in the ROI was calculated by comparing total facility construction in-migration over the period in which construction occurs with baseline ROI population forecasts over the same period. Impacts were expressed in terms of the percentage point difference in the average annual population growth rate with and without project construction. Forecasts were based on data provided by the U.S. Bureau of the Census.

J.3 IMPACTS ON LOCAL HOUSING MARKETS

The in-migration of workers during construction and operation could substantially affect the housing market in the ROI. The analysis considers these impacts by estimating the increase in demand for rental housing units in the peak year of construction and the increase in demand for owner-occupied units in the first year of operation; these demands would result from the in-migration of both direct and indirect workers into the ROI. The impacts on housing were described in terms of the number of rental units required in the peak year of construction and the number of owner-occupied units required in the first year of operations. The relative impact on existing housing in the ROI was estimated by calculating the impact of stockpile destruction-related housing demand on the forecasted number of vacant rental housing units in the peak year of construction and on the forecasted number of vacant owner-ccupied units in the first year of operations. Forecasts were based on data provided by the U.S. Bureau of the Census.

J.4 IMPACTS ON COMMUNITY SERVICES

In-migration associated with the construction and operation of a chemical munitions destruction facility could translate into increased demand for educational services and public services (police, fire protection, health services, etc.) in the ROI. Estimates of the total number of in-migrating workers and their families were used to calculate the impact of destruction facility construction and operation on the core ROI county (or countries) in which the majority of new workers would locate. Impacts of the facility on county, city, and school district revenues and expenditures were calculated by using baseline data provided in each jurisdiction's annual comprehensive financial reports forecasted for the peak year of construction and the first year of operations and were based on per capita revenues and expenditures for each jurisdiction. Population forecasts were based on data provided by the U.S. Bureau of the Census.

Impacts of destruction facility in-migration on community service employment were also calculated for the core ROI county in which the majority of new workers would locate. The analysis used the estimates of the number of in-migrating workers and families to calculate the number of new sworn police officers, firefighters, and general government employees that would be required to maintain the existing levels of service for each community. Calculations were based on the existing number of employees per 1,000 persons for each community service. To analyze the impact on educational employment, the numbers of teachers in each school district that would be required to maintain existing teacher-student ratios across all student age groups were estimated. Impacts on health care employment were estimated by calculating (1) the number of physicians in each county required to maintain the existing level of service (calculations were based on the existing number of physicians per 1,000 persons), and (2) the number of additional staffed hospital beds required to maintain the existing level of service (calculations were based on the existing number of staffed beds per 1,000 persons). Information on existing employment and levels of service was collected from the individual jurisdictions providing each service.

J.5 IMPACTS ON TRANSPORTATION

Impacts from a chemical munitions destruction facility on transportation in the ROI were described in terms of the impacts that the increase in traffic would have on the major road segments used by existing employees to commute to and from the site. The analysis allocated the trips made by construction workers to individual road segments on the basis of the residential distribution of existing site workers. The impact on the existing annual average number of daily trips was then calculated, and the impact on the level of service provided by each individual segment was estimated. Traffic information was collected from state and county transportation departments.

J.6 IMPACTS OF ACCIDENTS

Impacts from an accidental release of chemical agent were estimated in terms of losses in agricultural output and losses in business activity resulting from temporary evacuation. Because it is not possible to determine the geographical extent of any accidental release or the magnitude of damage to crops and livestock, a number of assumptions were made. The analysis assumed that all agricultural activity up to 30 mi (50 km) away from the facility could be affected by an accidental release. All counties lying either partially or completely within this region were included in the impact analysis. The analysis also assumed that any output affected would be quarantined, either by federal or state authorities or through voluntary action by producers, to avoid possible stigma effects. Because it is not possible to predict the likely wind speed and direction and the amount of chemical agent that would be released, it is also not possible to determine the volume of agricultural output that could be lost. The precise nature and location of specific crops and livestock are also unknown, since any given field could conceivably be used for a range of crops and animals over the duration of facility operations.

APPENDIX K

PUBLIC COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND U.S. ARMY RESPONSES

K.1 INTRODUCTION

As part of the NEPA scoping and public involvement process (see Sect. 1.4), members of the public and interested organizations and agencies were asked to provide comments on the Draft Environmental Impact Statement (DEIS) that would be used in preparing this Final EIS (FEIS). In addition, the Army solicited comments as part of four public meetings that were held regarding the proposed action: two on June 6, 2001, at the Pueblo Convention Center and two on June 7, 2001, in Avondale, Colorado. The oral comments offered at those meetings were transcribed by a court reporter. Written comments were accepted during the 90-day comment period (May 11–Aug. 9, 2001) following publication of the DEIS. All oral and written comments were reviewed and then categorized by subject area: (1) potential accidents; (2) adequacy of the DEIS; (3) air quality and emissions; (4) cumulative impacts; (5) environmental justice; (6) facility closure, decommissioning, and potential future uses; (7) human health; (8) socioeconomics and infrastructure; (9) technology issues; (10) terrestrial and aquatic ecological resources; (11) waste management; (12) water quality and use; (13) minor revisions and clarifications; and (14) out of scope comments and comments noted.

This appendix presents the public comments by subject area and provides the Army's responses to the comments. In addition to specific comments and responses in each section, a general summary of all comments is provided as an introduction to each subject area. Some of the comments are not reproduced verbatim; they have been paraphrased, combined, and/or summarized to avoid repetition among comments. Other comments are reproduced verbatim.

K.2 LIST OF COMMENTERS

Written comments on the DEIS were submitted by the 52 individuals or organizations listed below. The comment categories in which each commenter's statements are given or are paraphrased are given in brackets after the commenter's name (Sect. K.3)

K.2.1 Speakers at the Public Meetings

- David Barber [AD-1, AD-2, AD-3, AD-19, AQ-2, AQ-3, TI-7]
- Margaret Barber [AD-2, AD-3, AD-4, AD-9, AD-16, AQ-2, AQ-3, EJ-2, HH-4, TI-7, WM-1, WM-12]
- Michele Bobyn [AD-4, AD-13, AD-14]
- Suzie Bodecker [CI-1, SOC-4]
- Ann Cain [AD-2, FC-1]
- Robert Cain [FC-1]
- Stephen Caogi [WQ-8]
- Doug Gale [TI-12]

- Diane Hart [AD-18]
- Dan Hobbs [AD-2, CI-4, SOC-1, SOC-2]
- Larry Howe-Kerr [TI-7]
- Michelle Latka [ACC-1, AD-1, AD-25, AQ-1, CI-2, EJ-7]
- Helen Lyons [HH-1]
- Robert Muhaney [CI-2]
- Bill McKnight [SOC-2]
- Dorothy M. Olivier [SOC-2, WQ-1, WQ-2, WQ-3, WQ-4, WQ-5, WQ-6, WQ-13]
- Helen Quintana [no specific comment regarding the proposed action]
- Charlie Skidmore [AD-2]
- JoAnn Solano [FC-2, HH-1]
- Ross Vincent [no specific comment regarding the proposed action]
- Roberta Wallace [CI-4, SOC-1, SOC-2]
- Kathleen Wilson [AD-8, AD-17, HH-10]
- Douglas Wiley [ACC-29, AQ-1]
- Sherry Yatze [WQ-7]

K.2.2 Commenters Providing Written Comments

K.2.2.1 Individuals

- Mrs. W.C. Borkhoefer [AD-4]
- M.M. Barber [general statement of support for neutralization/biotreatment]
- D.L. Barber [general statement of support for neutralization/biotreatment]
- Susan Finzel-Aldred [general statement regarding adverse effects of incinceration]
- Cathy Garcia [general statement of support for neutralization]
- Donald and Katherine Gibbs [AD-2, AQ-1, AQ-2]
- Rick Hanger [AD-2, AD-3, SOC-1, TI-7, TI-12]
- Diane Hart [AD-2, AD-9, HH-14, SOC-1, TI-7, WM-14, WQ-1, WQ-12]
- Michelle Latka [ACC-1, AD-1, AD-25, AQ-1, CI-2, EJ-7]
- Gary and Helen Lyons [FC-1]
- Ruth Muhaney [WM-12]
- Robert Muhaney [CI-2]
- Dorothy M. Olivier [SOC-2, WQ-1, WQ-2, WQ-3, WQ-4, WQ-5, WQ-6, WQ-13]
- James G. Reavis [ACC-3, AD-2, AQ-21, TI-12, WM-14, WM-22]
- Kenneth Renoux [general comment regarding accidents]
- Lisa Shafer [HH-4, SOC-1, SOC-2]
- Roberta Wallace [CI-4, SOC-1, SOC-2]

K.2.2.2 Private organizations and groups

- Boone-Avondale Citizen's Alliance, Mitzie Martinez, Daniel G. Hobbs and Doug Wiley [AD-2, CI-4, SOC-1, SOC-2, TI-1, WQ-1, WQ-2, WQ-3, WQ-4, WQ-5, WQ-6, WQ-13]
- Citizens for Clean Air and Water in Pueblo and Southern Colorado et al. [ACC-1, ACC-8, ACC-9, ACC-10, ACC-15, ACC-16, ACC-17, AD-2, AD-3, AD-4, AD-6, AD-8, AD-9, AD-10, AD-11, AD-12, AD-13, AD-14, AD-15, AD-16, AD-17, AD-18, AD-19, AD-20,

AD-21, AD-22, AD- 23, AQ-1, AQ-2, AQ-3, AQ-4, AQ-5, AQ-6, AQ-7, AQ-8, AQ-9, AQ-10, AQ-11, AQ-12, AQ-13, AQ-14, AQ-15, AQ-16, AQ-17, AQ-18, AQ-19, AQ-20, AQ-21, CI-3, EJ-6, FC-1, FC-2, HH-4, HH-12, HH-14, TAE-5, TI-1, TI-2, TI-5, TI-6, TI-7, TI-8, TI-9, TI-10, TI-11, TI-12, TI-13, TI-14, TI-15, TI-16, TI-17, TI-18, TI-19, TI-20, SOC-1, SOC-7, SOC-15, SOC-24, WM-12, WM-13, WM-27, WQ-12, WQ-13]

- Kornelly and Associates, Irene Kornelly, President [ACC-9, ACC-10, ACC-12, ACC-13, AD-2, AD-8, AD-9, AD-10, AQ-1, AQ-11, AQ-21, EJ-6, FC-1, HH-12, HH-14, SOC-1, SOC-5, SOC-7, SOC-12, SOC-13, SOC-14, SOC-15, SOC-16, SOC-17, SOC-18, SOC-19, SOC-21, SOC-22, SOC-23, SOC-24, TAE-4, TAE-5, TI-9, TI-18, WM-13, WM-14, WM-20, WQ-1, WQ-12]
- Pueblo Depot Activity Development Authority, Charles J. Finley, Executive Director [AD-10, SOC-5, SOC-6, SOC-7, SOC-8, SOC-9, SOC-10, SOC-11, SOC-12, TI-20, WQ-1, WQ-12, WQ-15, WQ-16, WQ-17]
- Rocky Mountain Farmers Union, Roberta Wallace, President, Pueblo County Rocky Mountain Farmers Union, and Dave Carter, President, Rocky Mountain Farmers Union [CI-4, SOC-1, SOC-2]
- Sacred Heart Los Pobres Migrant Center, Sister Nancy Crafton, S.C., Director [general comments on environmental justice and local agricultural workers—see especially EJ-2]

K.2.2.3 Local, state, and federal agencies and organizations

- Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, Harvey W. Rogers, Chemical Demilitarization Branch, National Center for Environmental Health [ACC-4, ACC-5, WM-12]
- Pueblo County Department of Emergency Management [ACC-1, ACC-6, ACC-7, ACC-8]
- Bill Sova, Council Member at Large, City of Pueblo [general comments on human health, costs, and waste management]]
- State of Colorado, Hazardous Materials and Waste Management Division, Joe Schieffelin, Unit Leader [ACC-9, AD-2, TAE-1, WQ-11]
- U.S. Environmental Protection Agency, Region 8 [ACC-2, ACC-3, AD-2, AD-3, AD-5, AD-6, AD-7, AQ-1, AQ-4, AQ-15, AQ-16, AQ-17, AQ-21, CI-5, EJ-3, FC-2, HH-5, HH-6, HH-9, HH-10, SOC-1, TAE-3, TI-5, TI-6, TI-8, TI-10, WM-3, WM-4, WM-5, WM-6, WM-7, WM-8, WM-9, WQ-1, WQ-5, WQ-9, WQ-10]

K.3 RESPONSES TO COMMENTS BY SUBJECT AREA

K.3.1 Potential Accidents

K.3.1.1 Summary of comments

Several commenters expressed concerns about potential accidents during operations at the proposed facility and during munitions storage, handling, and transfer activities—especially in terms of comparing operations versus storage in the igloos and comparing accident consequences among the alternative technologies. Some commenters were concerned about the effects of accidents on farmlands and agriculture, while other commenters questioned the methodology, dispersion modeling, assumptions, comprehensiveness, and results of the accident analysis. They also indicated that containment and cleanup issues should be more fully explained in the EIS. One commenter asked about off-site consequences of accidents, especially for people who cannot shelter in place (e.g., the nearby agricultural and transportation workforce). One commenter suggested that the accident analysis overlooks "the potential risk of lack of maturation and operating experience associated with the non-incineration technologies;" consequently, the reader cannot easily compare the "learning curve risks, if any or none, associated with implementing" the new or existing technologies. Other commenters indicated that (1) the area of potential impact determined from modeling studies should correspond to the Chemical Stockpile Emergency Preparedness Program (CSEPP) Protection Action Zone (PAZ) for PCD; (2) some statements regarding emergency preparedness are open to misinterpretation or do not adequately state the nature and extent of emergency planning associated with the proposed action; (3) there are considerable differences and apparent inconsistencies in the analyses performed by PMCD and ACWA; and (4) a maximum credible event must be adequately addressed, drawing upon the history of documented accidents at similar facilities. A few commenters observed that the DEIS analyzes a potential accident for the no action alternative but does not extend the scenario to operations at an incinerator. In general, commenters pointed to the need for consistent, process-specific accident scenarios and consequence-based, not risk-based, assessments.

K.3.1.2 Response to comments

ACC-1. The DEIS compares the potential impacts from the baseline incineration, modified incineration, neutralization, two neutralizations, and one no action. It says that accidents during disposal operations would be smaller than storage igloo accidents. Under neutralization, it says, because munitions and agent quantities would be similar to the baseline incineration alternative, the potential impacts would be similar but would be smaller than the impacts of the no action alternative. These statements suggest that because the amounts are the same, the impacts are the same. But you cannot compare quantity and quality in the same sentence and totally ignore quality.

Also, the statement that the impacts would be similar but smaller relies on plant design and operational decisions that will dictate the quantities of munitions and agent held at the destruction facilities awaiting treatment. The comparison goes on to state that potential accident consequences associated with the destruction facilities would be similar, regardless of the techniques selected, because munition and agent quantities at the facilities would be similar. Has the program committed to those standards and limitations?

Response. The Draft EIS was attempting to say that the accidents of greatest concern to each of the destruction technologies would involve quantities of agents and munitions that (1) would be similar regardless of technology due to the similarity of the required destruction rates of the technologies and (2) would be potentially smaller than the quantities involved in any accident involving a storage igloo because of the larger inventory of munitions inside an igloo than in a demilitarization facility regardless of the technology employed. A 1996 risk assessment for the existing storage configuration at PCD shows that the crash of a large aircraft into a storage igloo would be the largest contributor to the existing storage risk and would also result in the largest downwind lethal hazard distance. The text referenced in the comment has been revised in this FEIS to clarify the author's intent. In addition, this FEIS shows a comparison of impacts from accidents that might affect either the incineration facilities or the neutralization facilities.

The quantities of agents and munitions to be present inside the destruction facility (regardless of which technology is selected) will be dictated by the terms and conditions of the RCRA permit. Because the munition throughput rates and agent destruction rates would be similar, if not identical, for any and all of the technologies, the quantities of agents and munitions present at any given time would be expected to be similar regardless of the technology.

ACC-2. The analysis of accidents should take into account the potential impact of an accident on farmlands and agricultural workers, many of whom—by virtue of their socioeconomic status and work histories—may be more vulnerable to exposures to hazardous substances. In particular, care should be taken to understand the nature of the workforce close to the PCD and to incorporate this understanding into the numbers regarding potential exposures.

Response. Section 4.22.14 of this EIS addresses the potential economic impacts to agriculture in the event of an accident. Furthermore, CSEPP does have elements in place to inform, notify, and therefore protect agricultural workers. If the decision is made to build an incineration facility at PCD, then a detailed evaluation of stack gas emissions would be prepared as part of a human health risk assessment for the facility. This risk assessment is also a required part of the RCRA permit for the facility and would also address impacts to farmlands, agricultural workers, and ecological resources around PCD. Agricultural risk assessment is also required for obtaining a Certificate of Designation prior to the start of construction.

ACC-3. Quantitative estimates of risk and supporting information should be presented for each of the alternatives in the FEIS. Currently, the EIS does not present quantitative estimates of risk for the two PCD incineration treatment alternatives. The risk estimates for the neutralization alternatives did not include supporting information or references. We also recommend adding quantitative risk or regulatory standards for comparison purposes. The revised risk estimates should also replace terms such as "allowable levels" with the specific levels and references to the standard or criteria.

Response. As requested in the comment, new text has been added to Sect. 4.22 in this FEIS to present information about accident risks, as well as estimates of the potential impacts and risks of accidents for the incineration alternatives. In regard to the comment about additional quantitative estimates of risk, the comment is not clear as to what quantitative ACWA data are being discussed. Section 4.9.3.5 of this FEIS presents ACWA risk information for normal operations; however, the source of this information lies wholly with the ACWA program. New text has been added to this FEIS to indicate the reference for this risk information. The information equivalent to that presented for the ACWA technologies in Sect. 4.9.3.5 is not available for the incineration technologies. If the decision is made to build an incineration facility at PCD, then a detailed evaluation of stack gas emissions would be prepared as part of a human health risk assessment for the facility. This risk assessment is also a required part of the RCRA permit for the facility.

ACC-4. The discussion of potential impacts from hypothetical accidents seems to overlook the potential role of lack of maturation and operating experience associated with the non-incineration technologies. Maturation of the baseline technology is discussed in appendices; however, lack of maturation for non-baseline applications with lethal agents is not well described. It is generally pointed out that many process safeguards will be common to any technology; however, this still does not provide the reader with insight regarding learning curve risks, if any or none, associated with implementing either new technologies or existing technologies with new applications.

Response. Section 3.2, Sect. 4, and Appendix E have been revised to reflect the observations in the comment regarding the lack of maturity and operational experience with the non-incineration technologies.

ACC-5. In Sect. 4.9.4, the discussion of the impacts of the No-Action Alternative seems accurate for routine maintenance activities; however, it is our understanding that continued storage presents greater community risk than baseline technologies (and by inference, alternate technologies), when potentially catastrophic events are considered. As stated, there would be seem to be no reason to get on with demilitarization other than treaty commitments.

Response. The risks and potential impacts of accidents are discussed in Sect. 4.22 and Appendix H, and not in Sect. 4.9.4 as cited in the comment. New text has been added to Appendix H in this FEIS to discuss the risks of the alternatives, including the risks of continued storage. The risks to the community from continuing to store the PCD inventory of chemical weapons have been determined to be greater than the risks of destroying that inventory. In addition, text has been added to Sect. 3.5 to more clearly describe that the no-action alternative is not a complete alternative in that it does not provide a solution to the continuation of the existing risk of storage. The recent tragic events caused by an intentional terrorist act have re-surfaced security concerns, and in fact have increased the need to eliminate the risk from continuing to store a deteriorating stockpile of lethal chemical weapons.

ACC-6. The DEIS states (p. 4-159) that "...a bounding accident is used in this section to describe the potential impact that could create lethal airborne concentrations of agent HD at distances up to 50 km (31 miles) from the accident." If this modeling suggests the potential for fatalities from an HD mustard accident at distances up to 50 km from the edge of PCD's chemical storage area, and this is a credible use of the D2PC model, then the corresponding CSEPP PAZ for the Pueblo Chemical Depot should extend to 50 km, since that planning zone boundary is based on the "no deaths" distance as modeled with D2PC using a maximum credible event at the Depot. Also, the estimated potential fatalities associated with this storage accident scenario increases to 12,200 when a sensitive population (young, old and otherwise more susceptible to the affects of mustard) is factored in (see Sect. H.4.2 and Table H.7).

Response. Based on updated information from previously completed risk assessments for PCD, the bounding accident in this FEIS (i.e., the accident that illustrates the most severe effects) differs from that presented in the Draft EIS. Section 4.22 and Appendix H of this FEIS have been revised to show the downwind extent of the potential lethal plume as being reduced from the 50-km distance in the Draft EIS to 30 km. As explained in Sect. H.3.2 of Appendix H, there are a variety of reasons this distance provides a highly conservative (worst case) estimate, but is nevertheless appropriate for the type of bounding analysis used in this EIS.

In regard to the relationship between hypothetical accident distances and CSEPP, the boundaries of emergency planning zones under CSEPP are based primarily on the time-distance relationships that would be associated with accidental releases of chemical warfare agent. Other factors considered in the determination of CSEPP planning zones include theoretical plume arrival times, the distribution of people and resources around the depot, and other geopolitical information. The determination of CSEPP planning zone boundaries is ultimately made by local and state planning authorities. Although the Army does not encourage state and local planners to ignore low-probability worst case potential accidents (i.e., those resulting from catastrophic events, such as earthquakes or airplane crashes), the Army, FEMA, and other CSEPP participants have elected to use hypothetical accidents having a higher probability of occurrence for their emergency planning basis. Hence, there may be differences between the accidents used as a basis for CSEPP planning and those used to bound environmental impacts in this EIS.

As described in the revised text in Sect. 4.22 and Appendix H of this FEIS, the downwind distance and the estimated number of potential fatalities from such a "worst case" hypothetical storage event has been revised significantly downward from the numerical value presented in the DEIS.

ACC-7. In the DEIS (p. 4-183), there is a misleading statement regarding emergency preparedness challenges present during storage alone when compared to storage plus plant construction and operation. The “action” (destruction) versus “no action” (continued storage) scenarios do pose additional challenges to local emergency preparedness because of the increase in Depot-related traffic associated with disposal facility construction and operation.

Response. The emphasis in Sect. 4.26.3, as referenced in the comment, is on emergency planning that would be associated with potential releases of mustard agent during accidents. It is not clear from the comment why increased traffic during facility construction and operations would necessarily pose any additional challenges to local emergency preparedness planning. Because the potential impact distances and associated plume arrival times for hypothetical “worst case” storage accidents would exceed that of hypothetical accidents at the destruction facility, the existing statement in Sect. 4.26.3 regarding action vs no-action is believed to be accurate.

ACC-8. The accident scenarios associated with the “no action” alternative (continued storage) included in both the ACWA and PMCD documents show marked differences between the consequences associated with those accidents. Although the scenarios in both EISs are very similar and the same dispersion model (D2PC) is used, the outcomes are sufficiently different to bear mention.

Response. The authors of both the ACWA DEIS and this site-specific EIS for PCD have discussed the differences in the respective approaches for modeling hypothetical storage accidents. The analysis of storage accidents in this FEIS has been revised as the result of the discussions between the ACWA and PMCD modelers. The basis for the identification and description of the hypothetical "worst case" storage accident in this FEIS has been taken from a Quantitative Risk Assessment prepared in 1996. Section 4.22 and Appendix H of this FEIS have been revised to indicate that this accident would have a 30-km lethal downwind extent (as opposed to the 50-km distance presented in the Draft EIS). The revised analyses are expected to be more consistent in both the ACWA FEIS and this FEIS.

ACC-9. In Sect. D.1.3.2, one paragraph says that munitions are to be loaded on tractor trailers and another says they will be transported in Milvans. No where does the document mention ONCs. The risk assessment showing that Milvans are just as safe as ONCs has not been released to the State of Colorado Department of Public Health and Environment.

One of the dangerous points in the process is the transfer of munitions from the igloos to the facility. How is that going to be accomplished?

Response. The term "Milvan" is technically incorrect, and it is not used in the FEIS. Consideration is being given to using an intermodal shipping container (ISC), a shipping container used for the movement of military cargo, in lieu of the on-site container (ONC) for the movement of chemical munitions at Pueblo. The PMCD currently has Science Applications International Corporation (SAIC) under contract to complete a comparison of the two alternative modes of transportation from a risk standpoint. Preliminary study results indicate that movement with the ISC in lieu of the ONC would not pose an increase in risk to the workers, public or environment. Once the study is completed, results will be provided to representatives of the State of Colorado and County of Pueblo to ensure any issues they may have are addressed before a final decision is made on the method of transport to be used.

ACC-10. In looking at the “bounding accident,” the ACWA DEIS focuses on an accident that could occur during operations and includes an accident scenario for “no action.” The site-specific DEIS focuses on the “no action” accident and dismisses any scenario that could happen during operations with the exception of minor spills that could be easily contained. If we are to accept the fact that the “bounding accident” is one in which an aircraft would crash into an igloo and have a resulting fire, is it not just as likely that an aircraft could crash into the demilitarization building or the unpack area with a resulting fire? This would provide a “bounding accident” during the operations of a facility far greater than the described minor spills.

Response. The comment is incorrect about the accident analysis dismissing any scenario that could happen during operations. The Draft EIS describes how the hypothetical “worst case” storage accident would bound the impacts of any accident that might occur during operation of the proposed facility. The accidents during operations were therefore not “dismissed” but were captured by the bounding analysis of the storage accident.

In regard to the initiating event for a demilitarization building accident, new text has been added to Sect. 4.22 and Appendix H in this FEIS to describe such events. Previous risk assessments have concluded that an earthquake (and not an air crash) poses the greatest risk for the demilitarization building. This earthquake event is described and its impacts assessed in Appendix H of this EIS.

ACC-11. The Draft EIS has inadequately addressed the “maximum credible event.” Identifying an airplane crash into stockpiled weapons avoids the more important disclosure of letting people in the area know what is something that could happen within the process. In particular, at a minimum, PMCD should consider the event of a complete power loss and systems failure that would result in either a shutdown of the burner with already volatilized hazardous material, noting where that material would go or a release of material into the atmosphere. This and other possible accident scenarios and the impacts associated with them must be discussed.

Response. The phrase “maximum credible event” (MCE) has been avoided in this EIS because it is reserved for the types of existing chemical weapons operations that may be conducted by Depot personnel. In lieu of an MCE, this EIS identifies and analyzes the potential impacts from a "worst case" storage accident as identified by previous storage risk assessments for PCD. The selection of an airplane crash into storage represents an upper bound on the magnitude and extent of any credible accident involving mustard-filled munitions at PCD.

New text has been added to Sect. 4.22 and Appendix H of this FEIS to describe hypothetical accidents that might occur during operation of an incineration facility. These events were obtained from a previous risk assessment of the baseline incineration facility at PCD.

Regarding the situation where a complete power loss might occur, the incinerators and furnaces would remain hot for some time after any fuel flow were to cease. This remaining heat has been determined by the Army to be sufficient for the destruction of any residual mustard agent that might still be in the system.

As described in the introduction to Sect. 4.22, it is not the intent for the analyses presented in this EIS to be a detailed safety assessment. Additional risk assessments would be conducted, if an incineration facility is selected at PCD.

ACC-12. In the “worst case” storage accident scenarios, does the greater risk come from the crash and the spread of agent or the resulting fire?

Response. The “worst case” storage accident described in Appendix H of this FEIS is modeled as a single scenario involving an air crash followed by fire. A single downwind lethal hazard is used to characterize the consequences of this scenario. It is not possible to separate the consequences or risks of the crash from those of the resulting fire.

ACC-13. The site-specific Draft EIS did not include any numbers concerning the economic impact of the accident scenario. However, these numbers were included in the ACWA Draft EIS. Please include the economic impacts on an accident in the FEIS. In addition, no mention is made in either document as to how the public and businesses would be compensated for these losses.

Response. Section 4.22.14 of the site-specific Draft EIS does present information on the potential economic impacts to agriculture. Additional information from the ACWA Draft EIS has been included in Sect. 4.22.14 in this FEIS.

In regard to the compensation for any economic damages due to accidental releases of mustard agent, the Army would send an emergency claims team from the nearest Area Claims Office in the event of a major chemical incident, The claims team would be available to receive claims against the U.S. Army under the Federal Tort Claims Act and Military Claims Act. The claims would be analyzed against the requirements of these laws and paid, when appropriate. An additional assistance mechanism for the surrounding communities would be the Federal

Emergency Management Agency's disaster assistance program. Under this program, disaster assistance could be provided if the incident has overwhelmed the response capabilities of the State and local governments.

ACC-14. As far as response in the case of accidents is concerned, what measures and plans exist for the safety of farmworkers in the field?

Response. The CSEPP has elements in place to inform, notify, and therefore protect agricultural workers. The details are available in CSEPP documentation and are outside the scope of this EIS.

ACC-15. One commenter offered a lengthy list of incidents at the Tooele Chemical Agent Disposal Facility (TOCDF) and asked that they be considered in any determination of effectiveness or reliability of either incineration method and particularly be included in any assessment of Maximum Credible Event.

Response. The list of incidents offered in the comment is appreciated. An additional quantitative risk assessment (QRA) of the facility design and operation would be conducted, if an incineration facility is selected at PCD. The items listed in the comment would be considered in the preparation of this QRA.

ACC-16. The citizens and agricultural communities of Pueblo and surrounding counties must be assured that all actions necessary to prevent contamination or a perception of contamination of the air, soil, water, plants and animals will be taken. Sampling, monitoring, and testing should be conducted on a regular and ongoing basis by an independent third party. The lack of agricultural related information in the draft environmental impact statements must be adequately addressed before an environmental impact statement will be complete.

Response. The Army has initiated an agricultural assessment for the area surrounding PCD. Part of the protocol for that assessment includes environmental sampling and testing. Design of the testing protocol will be assisted by members of the public and the academic community. Emissions monitoring from the chemical agent disposal facility would be overseen by the state of Colorado.

Section 4.22.14 of the Draft EIS discusses the potential economic losses to agriculture that could accompany an accidental release of mustard agent. Text has been added to Sect. 4.22 in this FEIS to discuss the potential risks to agriculture during the routine operation of an incineration facility.

ACC-17. The EIS should provide data that demonstrate that modified baseline incineration is as safe as baseline incineration.

Response. Modified baseline incineration is not a new technology. It is the reconfiguration of an existing, proven technology and the application of lessons learned from the JACADS experience with the disposal of mustard filled munitions and lessons being learned from the disposal operations being conducted at the TOCDF. All the other incineration facilities also incorporate lessons learned to enhance safety and protection of workers, the public, and the environment. As ongoing operations-including the startup of chemical agent destruction operations at Anniston and Umatilla-progress, additional lessons learned will be applied to the modified baseline design to include documentation of data reflecting the safety of the process.

ACC-18. The EIS must discuss all reasonably plausible impacts from chemical weapons destruction activities, not just those associated with “routine handling and destruction activities” as stated on p. 1-6 of the Draft EIS. The EIS must include a discussion of risks to workers, as well as to the public.

Response. The assessment of accident impacts (as presented in Sect. 4.22 and Appendix I of the Draft EIS) includes hypothetical events that are not "routine handling and destruction activities." New text has been added to Sect. 4.22 and Appendix H in this FEIS to more fully describe the types of accidents that could accompany destruction operations. Potential impacts and risks to workers during operations are discussed in Sect. 4.9.3.1.

ACC-19. The reliance on a storage risk analysis (as described in Sect. 3.5) that was published in 1988 is inappropriate. More thorough analyses have been done since then, and the results of those efforts should be discussed.

Response. New text has been added to Sect. 4.22 and Appendix H in this FEIS to discuss the results of a quantitative risk assessment that was completed in 1996. The results from that assessment have been used to update and revise the assessment of accidents in this FEIS.

ACC-20. There is no discussion in Sect. 4.12.4 of possible impacts from a chemical agent spill (although it is given a thorough discussion in Sect. 4.22 on accidents). While it is assumed that all four technologies would not be significantly different in this respect, there is no acknowledgment of the possibility of a spill and its effects (e.g, during transportation of the munitions from the igloos to the facility). A reference to Sect. 4.22 might be included here.

Response. A spill of mustard agent would be defined as an accident. Accidents and their impacts are discussed in Sect. 4.22, as noted in the comment. However, Sect. 4.12.4 describes the impacts of routine operations; hence, additional discussion of accidents at this location in the EIS would not be appropriate. Other sections of the EIS follow this same format, wherein the impacts of construction and operations are discussed first, then accident impacts are discussed in Sect. 4.22.

ACC-21. Residents near some incinerators have been issued a kit that contains a roll of duct tape and a roll of plastic so that they can make a safe room in their homes. What happens to people who work outdoors and are away from shelter if there is an accident?

Response. The Shelter-In-Place (SIP) kit referenced in the comment is intended for use only in residential structures. The kits are designed to enhance the sheltering potential of residential units during a chemical agent vapor release. A strategy to protect businesses and their employees is a concern that should be addressed by individual businesses as part of their contingency planning for emergencies. The CSEPP office, as well as your local emergency operations official, can offer advice on the plans for dealing with such emergencies.

ACC-22. The DEIS states (p. 1-5) that “the risks and consequences of possible accidental releases of chemical agent are described and compared among alternatives.” The risks and consequences of releases of substances other than chemical weapons agent must be identified and discussed as well.

Response. Chapter 4 of the EIS includes the assessment of potential environmental impacts of all types of possible emissions under standard operating and accident conditions for alternatives.

ACC-23. The DEIS states (p.1-5) that “CSDP FPEIS clearly showed that continued storage poses greater risk than the proposed action at PCD.” The CSDP FPEIS included claims, based on a woefully deficient risk analysis, that continued storage poses greater risks than destruction at the PCD. Subsequent risk analyses by the Army and other agencies have confirmed that the risks associated with continued storage are very low throughout the time likely to be involved in destroying these weapons, even under the most pessimistic projections, and that the storage risks for the particular stockpile configuration at the PCD are very, very low. Clearly, the greatest risks to public safety, public health and the environment occur during destruction.

Response. Risk assessment for PCD confirms that the accident which could cause the greatest loss of life and environmental damage is associated with continued storage.

K.3.2 Adequacy of the DEIS

K.3.2.1 Summary of comments

Many commenters indicated that the DEIS did not adequately and completely describe the proposed action and alternatives. The commenters felt that an objective comparison of the destruction technologies-and the identification of a preferred alternative-would not be possible without a more complete and consistent detailing of the specific processes involved, the waste streams, emissions, the consumptive use of resources such as water, and the potential environmental impacts of each technology. In addition, commenters offered questions and concerns about the

- role and importance of cost, schedule, and the Chemical Weapons Treaty deadline in the decision-making process;
- significantly different level of detail used in the ACWA and PMCD DEISs;
- inconsistencies between the ACWA and PMCD DEISs in the analyses of several resource areas and potential environmental impacts;
- alternatives analysis;
- cost estimates;
- adequacy, relevance, and reliability of the supporting data and reference material;
- misleading or unclear statements about impacts, such as the use of “below regulatory standards” to imply “no impact;” and
- inadequate or incomplete explanations of the analytical methods and results.

K.3.2.2 Response to comments

AD-1. The Chemical Weapons Treaty allows for a 10-year extension. If it takes until 2020 or 2025 to dispose of the munitions safely, so what?

Response. Continued storage is the alternative with the highest risk; hence, it is the least desirable alternative. The Chemical Weapons Treaty is an international treaty with high visibility among signatory and other nations. The Army is committed to the destruction of the Pueblo inventory by 2007. However, if only 85-90% of the inventory were to be destroyed by the treaty deadline, this would demonstrate a good faith effort at compliance. Additionally, in light of the recent intentional terroristic attacks, it becomes even more important to reduce the risk of continuing to store a deteriorating stockpile of deadly chemical weapons by destroying it in the earliest possible timeframe.

AD-2. One major area of concern for EPA stems from the discrepancies and lack of coordination between the two EISs. We note inconsistencies between the documents regarding power supply, water supply, wetlands, water consumption, contaminant emissions and communication upgrades. Suggested changes to the DEIS include: (a) improved presentation of the environmental analyses for comparison of technologies, (b) additional information specifically comparing the environmental impacts of each alternative for hazardous waste generation and air pollution, (c) additional information concerning air impacts and impacts on the agricultural community.

Response. Inconsistencies have been addressed to the extent possible using new information made available since publication of the DEIS. The publication of the ACWA Technology Resource Document in May 2001 and additional experiential information concerning emissions and wastes from PMCD have provided for improved assessment in virtually all the areas mentioned in the comment in this FEIS.

(a) New information has been added to Sect. 4 to provide improved understanding of environmental impacts.
(b) Section 4.6.3 of this FEIS has been updated with new information concerning the hazardous wastes produced by each of the alternative technologies.
(c) Section 4.7 has been updated with new information concerning air emissions. See also the information in Sect. 4.9.3.3 concerning the agricultural assessment.

For several reasons, however, a consistent side-by-side comparison of the technology alternatives cannot be easily established and presented. For example, while emission testing performed in support of both PMCD and PMACWA has shown that all proposed technologies would meet the applicable environmental requirements, these test data lack several common denominators that are necessary for a side-by-side comparison. The lack of these commonalities would present a misleading comparison of emissions between the technologies. The following factors outline these differences:

- Basis of test data—The ACWA test data used neat agent, bulk agent, and energetics as separate constituents in their testing (i.e., not actual munitions). PMCD used actual munitions (4.2-in. mortars filled with HD) in their testing. This will cause a varying off gas composition.
- Size of data set—The PMCD emission data for Modified Baseline is based on one trial burn with three runs, while the ACWA emission data is based on multiple tests with multiple runs.
- Control technology difference—All the tests varied in the type of pollution control equipment used and assumed different control efficiencies. For all technologies most of the control equipment that was used during testing was not an exact representation of the control equipment that will be specified in the final design.
- Scale of testing—ACWA's tests are bench scale, while the PMCD tests were conducted at an operating facility (i.e., JACADS).
- Varying throughput - Both PMCD and ACWA will have different process rates that would potentially affect emission comparisons.
- Operational schedule—The ACWA and PMCD operational schedule differ in duration for: systemization, trial burn/pilot testing, munitions processing, and closure.
- Secondary waste—PMACWA treatment test feeds included dunnage (i.e., wood pallets) and propellant, PMCD feeds did not.
- Different target analytes—While the majority of target analytes for both ACWA's and PMCD's emission tests are identical, there are several analytes that differ for each test.
- Natural gas vs. JP5—The PMCD test at JACADS used JP5 as fuel while the incinerator at PCD would use Natural Gas. Natural gas burns much cleaner than JP5.
- Recording of non-detectable analytes—For analytes that were tested but were not detected or were below the Method Detection Limit (MDL) PMCD used the MDL as the emission value, while AWCA used zero for these cases.
- Detectable levels—The MDLs differ between the PMCD and ACWA tests. The MDLs were established independently of one another for both the PMCD and ACWA tests. Therefore, the potential exists that some compounds would be detected by one test and not another.

AD-3. The FEIS should add a section comparing the pros and cons of the four technologies alternatives. The DEISs include the fundamentals of each technology, but did not identify which technology is likely to be the most “successful” (effective and efficient) in destroying munitions and mustard agent at Pueblo. Some of the factors which may be used to evaluate the technology are energy use; reliability; volumes and types of air pollution, hazardous waste, and other destruction byproducts; cost; ease of obtaining permits and ease of closure.

How would the information in this EIS help the U.S. Army to reach its Record of Decision if what we understand are the two main criteria, cost and schedule, are really poorly addressed, if at all, in this EIS document and the ACWA document.

Response. A new Sect. 1.4.6 in this FEIS describes the Defense Acquisition Board process which brings together all the types of information mentioned in the comment, as well as others (e.g. scheduling and public input), in order to make a fully informed decision concerning the technology to be used to destroy the PCD stockpile. The FEIS provides one source of information to the decision maker [i.e., the Defense Acquisition Executive (DAE)] responsible for selecting the technology to be used for destruction of the PCD stockpile. This includes information on process design, environmental impacts (inputs and outputs), costs, schedule, and public input. All these factors are important to the final decision. The DAE also receives input through an Integrating Team which includes three Working Teams (Cost/Schedule, Programmatic/Acquisition, and Safety/Environment) and an Overarching Team which brings together the input of the Integrating Team and the Citizens Advisory Commissions (additional public input). Should better/more definitive information become available in any of these areas after the completion of the EIS analyses, but before the publication of the FEIS, it will be made available through these mechanisms for consideration by the DAE.

The Record of Decision (ROD) will identify the environmentally preferable alternative(s), if the information in the FEIS supports such a finding. However, it is possible that no clear environmental advantage is discernible among the four alternatives under consideration for PCD. In any case, the decision maker must also consider other factors and the best available information. The ROD more fully address the reasoning behind the final decision.

AD-4. The DEIS lacks sufficient information and accurate facts. The document is incomplete and needs additional work. And we need additional public hearings when those can really be meaningful.

Response. Since publication of the DEIS, the ACWA Technology Review Document, a referenceable report describing the neutralization technologies, has been published. The best available information concerning the two incineration and two neutralization alternatives has now been presented and referenced in the FEIS. Under NEPA, a 30-day comment period will occur following publication of the FEIS.

AD-5. The PMCD EIS does not include the alternatives of building two ACWA facilities. Although this decision appears unlikely at PCD, for consistency with the ACWA EIS the PMCD EIS should include this alternative.

Response. PMCD does not believe that the building of two ACWA facilities at PCD is a credible possibility. As NEPA is intended to address credible/viable outcomes, PMCD decided not to devote resources to assessment of that scenario.

AD-6. The Executive Summary is weak in comparing the alternatives. This summary did not answer basic questions such as which technology is the quickest to implement, the least expensive, the least risk, has the greatest benefit to the local community, and so forth.

Response. The Executive Summary has been enhanced and strengthened with the updated and enhanced information from the revised EIS. Also see the responses to Comment AD-2, AD-3, and AD-4.

AD-7. Figure 2.5 shows alternative locations A, B, and C; however, there does not seem to be a discussion of the pros and cons of selecting the different locations. What are the differences in the environmental impacts for the three locations? What basis will be used for selecting one location over the others?

Response. In making the decision concerning location of the munitions destruction facility at site A, B, or C, the Army will attempt to avoid to the greatest extent possible impacts to flora, fauna, and water resources, and will consider the suitability of the underlying geologic formations as well as available access routes to the site.

AD-8. The phrase "exceeds a standard" can, to the layperson, have a double meaning. It should be explained more clearly in the EIS.

Response. The discussion of "standards" has been revised in Sect. 4.7 of the FEIS to better explain what the standards mean.

AD-9. Why does the site-specific DEIS provide all numbers in metric and the ACWA DEIS provide all numbers in the standard American system? This makes it very difficult for anyone to prepare a side-by-side comparison.

Response. In order to simplify comparisons of numbers between the PMCD and ACWA EISs all data are now presented in standard English units except where accepted conventions call for metric (e.g., air emissions concentrations are normally in micrograms per cubic meter).

AD-10. The permitting section of the site-specific DEIS does not consider the need for a Certificate of Designation if an incineration technology is chosen. This CD must be issued by the Pueblo Board of County Commissioners (BOCC) in conjunction with the RCRA permit issued by the State of Colorado.

Response. The Certificate of Designation has been added to Sect. 1.7 regarding the legal framework and Sect. 4.2.7.1 on permitting.

AD-11. Responsibility for the issuance of both draft and final ElSs for chemical weapons disposal at the Pueblo Chemical Depot has been misplaced. Thus, the integrity and the validity of the required NEPA review have been seriously compromised. NEPA requires preparation of draft and final EISs by federal officials responsible for decisions that may have a significant impact on health or the environment. There is only one impact-generating decision to be made with respect to the chemical weapons currently stored at the Pueblo Chemical Depot: viz., what kind of facility (or facilities) to construct and operate at that Depot to destroy the weapons there. The decision to construct generates the impacts subject to NEPA review. Neither the PMCD nor the PMACWA has the authority to make that decision for the Pueblo Chemical Depot. Thus neither has the responsibility or the authority to issue the draft or final EIS. The Defense Acquisition Executive will make that decision, we understand. The decision to bifurcate the NEPA review for Pueblo and to charge non-decision-maker (PMCD and PMACWA) with the responsibility for issuing the draft ElSs was a mistake.

Response. Work within the Department of Defense, as within most large organizations, is accomplished through delegation of responsibilities for sub-components of large undertakings to various parts of the organization. The Defense Acquisition Executive (DAE) has the responsibility for making the decision concerning the technology to be implemented at PCD for destruction of the chemical munitions stockpile. The EIS assessment of the four alternatives under consideration for implementation at PCD will provide one source of information for decision making by the DAE. Responsibility for preparing this EIS has been delegated to PMCD. Under Congressional mandate, ACWA has responsibility for testing alternatives to incineration for destruction of chemical munitions. The ACWA EIS concerning whether to pilot test either of two neutralization technologies at PCD has provided input concerning the ACWA technologies to the preparers of the PMCD DEIS for stockpile destruction. The Army Corps of Engineers has also been delegated responsibility to ensure that the PMCD and ACWA efforts are coordinated and are as consistent as possible, realizing that the two EISs have very different purposes.

AD-12. What impacts follow from conclusions that can be drawn from recent publications that have documented mismanagement on the part of PMCD, such as the February 2001 Army Audit Agency report where managers who made some 3,000 design changes “didn't assess the full cost, schedule, environmental and operational effects.” In addition there is the testimony before the U.S. Subcommittee on Chemical Demilitarization on April 25, 2001 and the review of that testimony by the Congressional Research Service dated May 14, 2001. How might these indicate impact of schedule, cost, safety, honesty, and accountability?

Response. The Army Audit Agency (AAA) conducted the cited investigation nearly 2 years before the report was finalized and released in February 2001. Management items offered as recommendations and criticisms in that report were either already addressed or being addressed. The report was not rooted in current reality. Secondly, while the statement about over 3000 changes is fundamentally true, the AAA did not evaluate all changes. They took a small sampling and extrapolated the data from there. If changes were made without assessing the full impact on such factors as cost and schedule, those changes resulted from adhering to the program's top priority-safety, regardless of cost. The issue of the Senate hearings was addressed in an information paper on the Task Force 2000 report.

AD-13. Section 1.1 is an inappropriately biased advocacy discussion for incineration. It should be rewritten and limited to essential, balanced introductory information.

Response. The information provided in the introduction provides necessary background for understanding the development of the alternatives for destruction of the PCD stockpile.

AD-14. The DEIS statement (p. 1-2) that “The National Research Council (NRC) has endorsed incineration as the method of choice for destroying the stockpile of chemical agents and munitions” is imprecise and potentially misleading. In fact, a committee of the NRC, one of several that reviewed chemical weapons destruction, endorsed incineration. Other NRC committees have endorsed other technologies since then.

Response. The endorsement of incineration by the NRC is important to understanding the construction and operation of JACADS which successfully completed destruction of the Johnston Island stockpile in November 2000.

AD-15. Regarding Sect. 1.2, the purpose and the need for this project are one and the same: “compliance with U.S. Public Law 99-145 and the CWC.” The “safe and environmentally sound destruction” of the weapons is a matter of methodology, not of purpose or need. The “elimination of the risk. . .from continued deterioration of the munitions in storage” is very small and smaller at Pueblo than at most of the other chemical weapons sites. It would not warrant a program of this magnitude and cost to the taxpayer were it not for the legal mandates. These irrelevant references should be removed.

Response. National and international law call for expedient disposal of chemical munitions stockpiles because of concerns associated with continuing to store them. Additionally, as a result of the events of September 11, 2001, there is now the potential for a terrorist attack to initiate the scenario which was previously analyzed as the highly improbable worst case bounding accident, (i.e., an aircraft crash into a storage igloo).

AD-16. The DEIS states (p. 1-5) that baseline incineration is “a demonstrated destruction process.” All the technologies that make up all the systems under consideration have been “demonstrated,” and the Army's experience with baseline incineration has been highly problematic. The problems associated with incineration should be disclosed and discussed candidly in this EIS.

Response. There are no "problem free" technologies or systems. Problems which did occur during JACADS operations have been fully disclosed to the public prior to the publication of the DEIS, and have been used to develop lessons learned documentation to improve operations at other locations.

AD-17. Section 1.4 discusses only opportunities for public comment, not for public involvement. In fact, there have been very few opportunities for public involvement in decisions affecting the chemical weapons disposal process at the PCD. No mention is made of the Colorado Chemical Demilitarization Citizens Advisory Commission.

Response. Citizens' Advisory Commissions are discussed in Sect. 1.8, along with similar information regarding the ACWA Dialogue.

AD-18. (DEIS, p. 2-1) When were the various chemical weapons created and brought to PCD, and what was their source?

Response. Production of chemical munitions by the US DOD ended in the mid 1960s. Such munitions have been stored at PCD since the late 1960s.

AD-19. Please list the known or suspected impurities, and their estimated quantities, of the various mustard agents.

Response. Specific data on impurities and amounts in mustard agent are not currently available.

AD-20. The DEIS refers to (p. 2-6) “explosives used to disperse the mustard agent include tetryl, tetrytol, Composition .45, Composition B4, and trinitrotoluene (TNT). Composition A5 is the explosive RDX mixed with stearic acid. Composition B4 is a mixture of Y7VT and RDX (CBDCOM 1997). Tetrytol is a mixture of tetryl and TNT.” The full chemical names of these compounds (and propellants) should be provided and, if possible, diagrams of their chemical structure.

Response. It not clear how additional technical detail on these compounds would benefit the public or the decision maker. Hence, no further information is offered, and no changes to the EIS have been made.

AD-21. Please detail the “detailed procedures” (p. 2-17) that would be developed for handling of munitions.

Response. Procedures developed would be based on lessons learned from previous chemical munitions destruction operations and on regulatory standards to ensure safety and environmental protection.

AD-22. Attempts to locate the Mitretek document (U.S. Army 2001) cited on p. 2-17 failed. Does this document indeed exist?

Response. The Mitretek Phase 1 is available on the PMCD web site and the Phase 2 report is currently in draft and not yet available. The text has been revised accordingly.

AD-23. Please incorporate the latest results available from the June tests of 4.2-in. mortar disassembly and access to agent with high pressure water, by ACWA technologists at CAMDS/TOCDF.

Response. Detailed technical information concerning the ACWA processes can be viewed in the ACWA Technology Resource Document (May 2001).

AD-24. (Section 2.3.3). The State of Colorado has not been delegated authority to oversee federal water quality at federal facilities; EPA has retained this authority.

Response. The text in Sect. 2.3.3 has been revised accordingly.

AD-25. The DEIS gives (p. 3-14) operations schedules for the incineration and neutralizations alternatives. This section and the accompanying Table 3.1 should be reviewed carefully and revised as needed. We have been advised, for example, that the data presented for the neutralization systems is not based on 12-hour/day operation and that the incineration systems cannot operate 24 hours/day.

Response. The operational periods described in the DEIS for incineration and ACWA technologies are correct. The Army intends to schedule maintenance while the disassembly equipment is changed over for the next munition.

K.3.3 Air Quality and Emissions

K.3.3.1 Summary of comments

A number of commenters pointed to the importance of air quality and emissions issues for incineration technologies, especially those for chemical agent destruction. These commenters felt that the presentation of the air quality and emissions analysis should be improved so that the impacts of the various alternatives can be compared more easily. Several commenters asked for a comprehensive listing of the toxic air pollutants that may be emitted by the proposed facility. Other commenters were concerned that the DEIS analysis relies on modeling and projections rather than actual data, previous experience, and monitoring. Moreover, the commenters indicated that the data in the DEIS are inconsistent not only with the ACWA DEIS but also with several existing air quality permits issued by the State of Colorado. They further noted that emissions from existing incinerators cannot be quantified exactly, and they felt that-under certain upset conditions-incinerators may emit agent before the operations can be shut down. Some commenters questioned the accuracy and usefulness of data from trial burns and operations at other facilities such as JACADS and Tooele. Two commenters asked about the effect of inclement or unusual weather (e.g., high winds) on the incineration process and emissions. Some commenters were especially concerned about emissions of dioxins, especially in light of the potential human health impacts. One commenter offered several suggestions for improving the analysis and modeling of ozone levels and hazardous air pollutants and asked for clarification of how the proposed action will comply with several regulations (e.g., the Hazardous Waste Combustion Maximum Achievable Control Technologies Rule). Some commenters felt that the DEIS emphasized regulatory compliance rather than potential impacts, and they asked that the DEIS be revised to include more specifics about those potential impacts. In particular, these commenters want the DEIS to make clear that compliance with standards does not necessarily ensure that emissions have no environmental impact. Also, one commenter asked that non-process emissions, such as vehicle emissions associated with material delivery and waste removal, be considered in the analysis. Another commenter saw the DEIS analysis of mercury emissions as inadequate and requested a more detailed review and evaluation. Some commenters asked for the addition or clarification of several specific aspects of the proposed action that affect the type and quantity of emissions, including pressure and flow conditions in the incineration process, the use of carbon filters, and the need to volatilize the agent before incineration. A number of commenters asked for specific information about the use and role of monitoring of emissions during incineration. One commenter indicated that the DEIS description of air quality and emissions is incomplete and sometimes misleading and superficial; the commenter offered several suggestions for clarifying the discussion, improving the consistency between the ACWA and PMCD EISs, and incorporating relevant data.

K.3.3.2 Response to comments

AQ-1. A complete list of toxic air pollutants, including noncriteria pollutants, is missing in the DEIS. The ACWA DEIS has several pages of lists of toxic air pollutants. Those lists are completely omitted from the PMCD document. Please provide the information in pounds per year or percentage of tons per year. Other examples of missing information include estimates of the amounts of CO_2 and PM-2.5 to be emitted.

Response. A new appendix, Appendix I, has been added to this FEIS to address the concern in the comment about air pollutants and their emission concentrations. The information in this new appendix presents the ACWA data described in the comment; however, it should be noted that the list of potential constituents of concern related to neutralization air emissions is largely theoretical and is based on the assumed performance of the neutralization systems. The data for the incineration technologies in the new appendix was obtained during actual combustion test burns at the Army's JACADS facility.

PM-2.5 was not a criteria pollutant at the time the analyses for the DEIS were prepared; however, as per a U.S. Supreme Court decision in February 2001, PM-2.5 is now a criteria pollutant. Assessments of PM-2.5 and the new 8-hour ozone standard (that will also become effective during the life of the proposed project) are presented in Sect. 4.7 of this FEIS. Data on CO_2 and other greenhouse gases are not yet available.

AQ-2. It is extremely difficult to determine the exact constituents of stack emissions; the fact that the Army found dioxin proves that point. At Tooele, the Army found unexpected compounds in the emissions. There have been many surprises. We don't know all of the surprises at JACADS, but we do know a lot of the surprises at Tooele, including a known leak of nerve agent that actually got out of the stack. There have been many, many documented cases that were probably agent escaping into the atmosphere, but the Army and civilian contractors have been able to cover those violations up. There have been many violations at Tooele that have been more or less covered up. So testing of stack emissions is a little bit better than voodoo science.

Response. The potential impacts of process fluctuations are addressed in Sect. 4.7.5 of this EIS. The Army has obtained extensive data on the actual incinerator emissions from the JACADS and Tooele facilities. Compliance with emission standards at JACADS was overseen by the U.S. EPA and by the state of Utah at Tooele. To date, these facilities have proven their ability to operate in a safe and environmentally acceptable manner. Similar oversight by EPA and the state of Colorado would occur if an incineration facility were to be built at PCD.

AQ-3. The only testing has happened at the JACADS facility, but I have been told that the test did not meet air-quality standards, nor was it independently monitored and overseen.

Response. For the modified baseline incineration alternative, the commenter is correct in that test burns were conducted at the Army's JACADS facility (see the response to Comment TI-7). Extensive stack gas measurements were obtained from four separate test burns. The results of these test burns are presented in Appendix I, a new appendix prepared for this FEIS.

If a modified baseline incineration facility is constructed and operated at PCD, then it would be required to pass rigorous emission standards set by EPA and the state of Colorado. The ability of the facility to comply with such standards would have to be proven in a set of trial burns (see Sect. 4.27.2 in this EIS) to be completed prior to the full-scale destruction of the PCD inventory.

AQ-4. Because the NEPA process is about impact, not about meeting standards, the impacts of incinerator operations that meet standards should be described in more detail, particularly in the area of air emissions. An enhanced discussion of emissions associated with accidents or off-normal operations should also be provided, especially in light of how often normal operations have been exceeded and how often standards have been exceeded in terms of release of toxic materials.

Response. The potential impacts of process fluctuations are discussed in Sect. 4.7.5 of this EIS. In addition, if the decision is made to build an incineration facility at PCD, then the types of "plant upset" conditions described in the comment will be included in a detailed human health risk assessment for the facility. This risk assessment would be required as part of the RCRA permit for the facility.

AQ-5. If the facility had to be shut down because of inclement weather, could there be unexpected problems with increased emissions. Also, if there are fluctuations in the product being fed into the incinerator, can the emissions from the stack increase?

Response. In regard to inclement weather during routine operations, the analysis of plant operations in this EIS includes all such weather (and dispersive conditions) as measured over a multi-year period. The shutdown of the incinerator(s) would normally be done in stages, with the agent and munition feed halted long before the fuel supply were shut off. For the questions regarding process upset conditions, see the response to Comment AQ-4.

AQ-6. Emissions from stacks when incineration is the technology are not well known, and the DEIS assumptions are based on modeling, not actual monitoring. The cost of continuous monitoring is very high. The actual composition of the emissions will vary depending on the compositions of the materials being incinerated, the design of the facility, and the rate of accumulation.

Response. Emissions estimates are based on modeling, as well as comparisons of model estimates with actuarial experience of full-scale incineration facilities from trial burns at JACADS.

AQ-7. In Table 4.12, the PMCD document misrepresents the ACWA figures. We have to assume that each group is giving the best figures they know for their own technology, but percentage of error is as much as several thousand percent as it is in the case of SO_2. The effect of this misrepresentation influences how the chart is interpreted. In almost all cases, the incineration technologies still emit more of the criteria pollutants. But the difference is smaller with the figures that they have given.

Response. The data on neutralization used in the draft version of this EIS were obtained from ACWA. Discrepancies have been noted between the PMCD and ACWA EISs. An attempt has been made to present the most accurate ACWA information and data available. The FEIS has been revised using data published in the ACWA Technology Resource Document (May 2001).

AQ-8. The PMCD document says there's 153 freeze-free days per year in Pueblo. The ACWA document says there are 209 freeze-free days per year.

Response. The number of freeze-free days in the PMCD EIS comes from the *Climatic Atlas of the United States*.

AQ-9. Air quality permits at the state health department have numbers in the Prevention of Significant Deterioration (PSD) studies that are very different from the numbers that used in the DEIS. If you use different numbers from what the state is accepting in the other documents, you may have permitting problems. Background levels in Pueblo of SO_2 are currently 125 parts per million. A company just received a permit a few months ago to use up two-thirds of the difference between 125 and what the state thinks is the maximum allowable of SO_2 without going over the standards of 200. This company is using up 50 parts per million, leaving only 25 for any new industry. According to the charts provided, incineration will produce 5,133 tons per year of SO_2. That amount would not be allowable according to the permitting materials that I've been reading at the state level.

Response. PSD allowances depend on location; determination of these allowances for any particular location is made by the Colorado Department of Public Health and Environment (CDPHE). Any major stationary source (e.g., the proposed project) will have to satisfy the CDPHE that the allowances will not be exceeded. This is the topic of the Air Permit Application.

AQ-10. There is a wind rose included in the DEIS. Two weeks ago, an 80 mile-per-hour wind occurred in Pueblo and picked up soil on the Depot. If there's anything deposited around that Depot, it was on us. It was on the farmland then.

Response. Comment noted. Two years of data have been collected for analysis of wind patterns in the area; high winds, as well as periods of calm, are included.

AQ-11. Throughout both DEIS documents, the Army indicates that no significant impact will result from the construction or operations of a facility based on the fact that the emissions from the proposed plant will not be above the limits established by the State of Colorado. However, this statement leaves a false impression that emissions limits are indicative of health risk limits. This is not always the case. Adverse impacts can and do occur even when emission levels fall within the established guidelines.

Response. EPA or State of Colorado standards are supported by extensive research into the potential impacts of the regulated substances on human health or the environment, and are set a levels well below those which research indicates would initiate harmful effects. The preparers of the EIS are not tasked to duplicate or revise the standards thus developed by the regulatory agencies. However, the discussion in Sect. 4.7 has been enhanced to better describe what the standards mean and how the values presented for the various alternatives relate to those standards.

AQ-12. The EIS states that regulatory requirements will be met, resulting in no impact. This is false. Regulatory requirements presume an acceptable level of impact, and these must be outlined. Even in the best industries all regs are not always complied with.

Response. Section 4.7 of the EIS has been revised to include a more thorough description of the meaning and basis of the standards, and a discussion of the relationship of the available data to the standards. It is expected that all air quality regulations will be met, with the possible exceptions of some trace materials present in quantities at or near or below detection limits.

AQ-13. The reports assume that the Colorado Ambient air Quality Standards are identical to the federal ones. With the 1997 federal promulgation of new standards for PM-10 and ozone, this is no longer true. The Colorado state standards for PM-10 and ozone are identical to the federal pre-1997 ones. Colorado has stricter standards for sulfur dioxide. Colorado Regulation 8 contains a lead standard that is stricter than the federal one, at 1.5 mg/m^3 for a one-month average. (The Federal lead standard specifies a quarterly average).

Response. The DEIS uses the correct sulfur standard. See Table 4.11 and footnote (f) concerning lead.

AQ-14. The DEIS (p. 4-35) suggests that a 1995 version of ISCST3 might have been used for air dispersion modeling. The Air Pollution Control Division normally recommends that the most recent version be used. When the permit application is submitted, details will need to be provided concerning model settings and assumptions.

Response. In the test, 1995 refers to the user's manual. The latest version of ISCST was used.

AQ-15. It does not appear that the DEIS contains tables with projected emission rates of criteria pollutants for each alternative.

Response. Criteria pollutant emissions for all alternatives are presented in Table 4.14.

AQ-16. Section 4.25.7 indicates that exceedances of health-based standards for criteria pollutants should not be expected. A sentence indicating that State regulations will also be met should be included as part of this section.

Response. Section 4.25.7 has been revised as suggested by the commenter.

AQ-17. Table 3.2 seems to incorrectly state that the only emissions resulting from the two ACWA technologies would result from boilers and generators. Impacts from emissions from the metal parts thermal treatment process, the catalytic oxidation processes, and from the SCWO processes need to be considered here for each ACWA technology, as applicable.

Response. Comment noted. The emissions cited in the comment are considered in Table 3.2 of the FEIS.

AQ-18. Section 4.7.5.1 indicates that white lead was used as a lubricant in projectile construction, and may be emitted from the incinerator. Some attempt to quantify these emissions should be made, as Colorado and the federal government both have standards for lead in ambient air.

Response. No data are currently available concerning lead emissions. However, as stated in the FEIS, based on the amounts used in lubrication, the emissions would be far below levels of concern.

AQ-19. Section 4.26.6 discusses the design of a perimeter air quality monitoring system. Please add CDPHE to the list of groups to be consulted regarding this issue.

Response. Section 4.26.6 has been revised as requested.

AQ-20. Section D.2.12.1 notes that only HD will be monitored. Monitoring for HT must also be addressed.

Response. The note in Sect. D.2.12.1 has been deleted. Monitoring will include both HD and HT based on the sulfur component.

AQ-21. Section 4.8.4.1 mentions that elevated levels of mercury were detected during trial burns of 4.2-in. HD mortar rounds at JACADS. For the incineration options being considered for PCD, describe the "enhanced monitoring, design changes, and operational modifications" that will be employed to control mercury emissions. Please explain in more detail how mercury emissions will be tightly monitored and how feed rates would be modified if mercury concentrations are unacceptable.

The current recommendation in the DEIS for controlling mercury emissions is to "actively monitoring the mercury emissions rates and modify the feed if mercury concentrations indicate changes from applicable emission levels." We recommend that the alternatives incorporate mercury capture or controls from the beginning of the process. We have not seen any information in the EIS to indicate that mercury will not be a problem. As discussed elsewhere in the DEIS, it appears that mercury is present in the munitions. Therefore, it does not appear that the Army will be able to change the feed into the mustard agent destruction facility.

Response. PMCD is currently evaluating the removal efficiency of the PFS, and specifically the effect of the carbon beds on mercury emissions. By replacing the type of carbon in the PFS, a greater removal efficiency for mercury may be achieved. Testing of the removal efficiency of the PFS is being conducted at ANCDF. It is not anticipated at this point the destruction process will need to be slowed down. The emissions must achieve regulatory limits prior to the facility being approved for operations.

The limits for toxic waste incinerators were developed by the Environmental Protection Agency after doing human health risk assessments for a wide variety of sites. Modification of feed is an acceptable way to limit effluent limits when effluents are regulated on the basis of material per unit of time.

K.3.4 Cumulative Impacts

K.3.4.1 Summary of comments

A few commenters said that the DEIS should more fully explain the potential environmental impacts of incineration in the context of other facilities and activities in the Pueblo area. They felt that existing emissions in the area might pose regulatory compliance concerns for incinerators and that the cumulative negative effects of water use should be more fully explained. Other commenters were concerned about existing contamination in nearby groundwater, and one suggested that the DEIS should “include a discussion of the combination of ongoing cleanup actions at PCD.”

K.3.4.2 Responses to comments

CI-1. The groundwater in Avondale is known to be contaminated, and the effects of the proposed action on this contamination should be evaluated. There is also contamination on the PCD site, and the proposed action may affect ongoing cleanup and remediation activities.

Response. Some groundwater at Avondale has been previously contaminated from the explosives products plume emanating from the TNT Washout Facility, a RCRA solid waste management unit. The groundwater is undergoing treatment both on-site and at the PCD boundary. No activities associated with any of the alternatives for destruction of chemical munitions would be expected to adversely affect the groundwater remediation activities.

CI-2. There is a regional environmental context created by numerous power plants, an aging steel factory, and a number of cement factories. The emissions from an incinerator are an unacceptable addition to the cumulative and adverse effects of these facilities, and the State may not be an effective regulator of the emissions from all these facilities. There may also be interactions among the emitted pollutants that should be evaluated.

Response. The proposed incineration facility is the subject of this EIS. Other pollutant sources in the area have monitored effects that were taken into account in the analysis of cumulative impacts. Cumulative impacts to air quality are addressed in Sects. 4.7.7 and 4.8.7. In addition, any major stationary source (such as the proposed project) will have to satisfy the Colorado Department of Public Health and the Environment that the allowances will not be exceeded. This is the topic of the air permit application. Interactions among the effluents and emissions from the various facilities in the area would not change the biological and environmental responses evaluated in the cumulative impacts analysis. Consequently, it is appropriate to estimate cumulative responses based on the total pollutant burden.

CI-3. Both DEISs have indicated that there would be cumulative negative impacts in which water might be diverted from other projects and there might be higher water prices. There is no indication what the other projects might be, and the resulting effects on agriculture and other off-site activities are not clear.

Response. The proposed water use by the munitions destruction facility would be far below the levels used by the Depot historically. Under normal operations, there should be no noticeable reduction in water availability to the surrounding area, including agricultural activities.

CI-4. Heavy metals and dioxins may be emitted in only small quantities, but certain vegetables (e.g., cabbage and broccoli) concentrate heavy metals in their leaves; and dioxin can be concentrated in meat. What is the cumulative effect of those emissions over the life of the project?

Response. Uptake through the food chain can be a large part of the impact to people, or a very small impact depending on factors such as the effluent materials, the transport through the environment, the types of foods, and locations of foods. This issue has been addressed by presenting the findings of the food pathway analysis vs the total analysis of human impacts for other incinerator sites. Three human health risk assessments (that include ingestion of locally grown foods) have been performed for chemical weapons incinerators based on actual emission data from the Johnston Atoll incinerator, and a fourth analysis has been performed with a combination of data from the Johnston Atoll incinerator facility and the Tooele incinerator facility. Thus, actual data, adjusted for differences that can be quantified, were used for four separate health risk analyses, two of which were performed by non-Army organizations: the State of Utah Department of Environmental Quality and the Oregon Department of Environmental Quality.

In addition, as part of the RCRA permitting process, the Army is performing a human health risk assessment, that includes the food chain pathway, prior to operational permitting. Finally, in order to determine the actual effects on local foods, the Army is in the process of designing an agricultural risk assessment which will include sampling of air, water, soil, sediment, and selected agricultural products. Samples will be taken prior to operation to provide baseline data for pollutants of interest. After operations began, periodic sampling would be used to document any changes in contaminant burden that could be associated with the facility.

CI-5. Section 4.23 should be revised to include impacts from groundwater remediation, other RCRA corrective actions, and base closure activities.

Response. The proposed action is not expected to have significant impacts to ongoing remediation activities (Sect. 4.13.4.1). Completion of the proposed action would facilitate base closure and reuse activities.

K.3.5 Environmental Justice

K.3.5.1 Summary of comments

Some commenters were concerned about the effects of the proposed project on minority populations, such as the migrant agricultural workers in the Pueblo area. These commenters felt that the proposed project might affect these workers disproportionately and that minority populations, especially migrant workers, are not part of the communication process surrounding the proposed action. One commenter suggested that the EIS include additional information about the demographics and income characteristics of minority populations potentially affected by the proposed project. Another commenter was concerned that the EIS analysis unrealistically relies on compliance with environmental standards and regulations to dismiss environmental justice concerns. The same commenter said that the existing environment in the Pueblo area contains levels of pollutants that are affecting the health of low-income and minority residents. A few commenters noted inconsistencies in the treatment of environmental justice issues between the ACWA and PMCD DEISs, and one commenter thought that the EIS analysis should evaluate the potential effects of the proposed project on migrant worker housing.

K.3.5.2 Responses to comments

EJ-1. There are omissions in the DEIS of important information, such as detailed lists of the quantities of toxic air pollutants. In a community with a 62.2 percent minority rate, these omissions raise very serious questions about environmental justice.

Response. EPA Region 8 and PMCD have noted the number of minorities and low-income populations in the community. The Army and FEMA developed the CSEPP (which is administered at the local county level) to protect all citizens in the event of an accidental chemical release. However, research has shown that disenfranchised groups may be additionally impacted during a disaster. These may include low-income or minority sub-groups, as well as the elderly, the mobility impaired, and single female headed households. Information has been added to Appendix H in this FEIS to further address this comment.

EJ-2. Many of the minorities and migrant workers do not know about the proposed project and its potential impacts. The communication with those communities has been poor.

Response. The comment is noted; however, the Army has maintained an outreach office in Pueblo to answer questions about the stockpile. CSEPP officials also meet regularly with citizen groups to address concerns. Additional information regarding the types of concerns expressed in the comment may be obtained from the local CSEPP office.

EJ-3. The DEIS describes the representation of minority or low-income populations, including Fig. 4.15, which illustrates the income characteristics of the population surrounding the PCD but not the racial and ethnic characteristics. An additional map is needed showing the distribution of minority communities in the area and their characteristics to indicate the proximity of minority populations to the Depot.

Response. Figure 4.15 referenced by the commenter in the DEIS has been deleted because it was based on 1990 Census data. Data concerning low-income populations are not yet available from the 2000 Census. Current documentation of poverty levels relies on 1997 model-based estimates (Sect. 4.21.1.2). Data are available from the 2000 Census on minority populations, and Sect. 4.21.1.1 has been updated accordingly.

EJ-4. The DEIS (Sect. 4.21.2) states that “Activities associated with chemical munitions destruction will not affect the existing populations of minority and/or low-income residents in the vicinity of PCD.” This statement is not consistent with the rest of the DEIS. While it appears there will be that no significant health effects during normal operations, there will be some impacts in these communities.

Response. The text has been revised to read “Activities associated with chemical munitions destruction will not significantly or disproportionately affect existing populations of minority or low-income residents in the vicinity of PCD.”

EJ-5. The DEIS asserts that “under normal operating conditions, the facility would be monitored continuously to ensure that any emissions remain below permitted levels and standards.” No amount of monitoring can ensure compliance, and it may not even succeed in identifying all of the exceedances. The assertion that compliance means no impacts is clearly and demonstrably false. If there are releases, there are impacts and those impacts must be discussed.

Historically, Pueblo County has ranked among the worst areas for pollutant emissions and the associated health effects. Citizens of Pueblo County have an illness rate 150% of the rest of the state in several categories, including cancer, heart disease, and pulmonary illnesses. The cause and effect relationship between pollutants and health has been convincingly documented, and new studies continue to confirm our worst suspicions. Clearly, incineration poses a much greater risk of air pollution than other methods. With a large minority population and one of the lowest per-capita incomes in Colorado, there is clearly already an environmental justice problem here. An incinerator would adversely affect efforts to foster environmental justice in this community. The towns of Boone and Avondale, as well as the communities of Blende, Eastern, and Southem Pueblo qualify as communities for which environmental justice principles should apply. In addition, to the east of PCD are the communities in Crowley County. Again, the migrant and seasonal farmworker community should not be relegated to invisibility because they are not noticed or acknowledged.

Response. The Army concurs that “no amount of monitoring can ensure that any emissions remain below permitted levels and standards” as an accidental release may exceed standards. The text in this FEIS has been reworded for clarity.

The comments related to environmental justice impacts on minority populations are noted. However, the number of migrants and seasonal farmworkers is noted as unknown on page 4-154, lines 14-17, of the Draft EIS. There is a paucity of information regarding such population sub-groups, and identifying their temporary locations in the vicinity of the Depot is not possible at this time. PMCD has and will continue to work with EPA to develop more complete information and provide that information when it becomes available. Text describing the maps available from EPA Region 8 showing the distribution of all TRI reporting facilities in Pueblo County has been added to Sect. 4.21 in this FEIS.

The issue of cumulative impacts on minority and low-income populations because of the existing lowered socioeconomic status is noted. However, as noted on page 4-66, lines 31-33, of the Draft EIS, “There are no past, present, or reasonably foreseeable on-post actions that would combine with any of the four alternatives to cause cumulative adverse health impacts to on-post workers and residents, and to off-post populations (see Sect. 4.8.7 and 4.8.8 for discussion).” The Army is preparing a site-specific human health risk assessment for the facility as part of the required RCRA permit, but this assessment does not examine contributions from sources other than the PCD facility because its goal is to assess impacts to human health from PCD agent destruction. Input from the commenters to that analysis would be appropriate.

EJ-6. The ACWA DEIS uses national census figures for 1990, and the PMCD DEIS uses Colorado census figures for 1990. Both reports should include both national and Colorado census figures in addition to databases that reflect the rnigrant/seasonal worker populations of the area. It is unclear why the information is presented differently in each report. In both DEISes the analysis considered population characteristics within a 50-km radius. The ACWA DEIS indicates that there were 62 census tracts within this 50-km radius. The PMCD DEIS breaks these tracts down to those completely within the 50-km radius and those partially within the radius. It is unclear why the figures for the census tracts are reviewed differently. The information should be presented in like formats for easier comparison.

Response.-The national and Colorado census figures for 2000 have been incorporated into the data for this FEIS. Because of the two different preparers of the DEISs, the information is presented in two separate formats. The PMCD analysis addresses the issue of proximity of minority and low-income population sub-groups to the source of hazard.

EJ-7. Both DEISs need to add comments on costs, including the costs to area farmers and ranchers of lost business when the public knowledge that dioxins are being emitted and may be getting into the food chain through purchase of their products. The increased medical costs for area residents, many of whom are the working poor and migrant workers who neither qualify for Medicaid nor can afford medical insurance, should also be included. Incinerator pollutants, added to the existing pollution in Pueblo County, may aggravate respiratory problems.

Response. Section 4.21.2 has been revised as follows: "Analysis of non-quantitative health care costs borne by highly susceptible minority and low-income population sub-groups is not possible at this time because the numbers and existing health care issues are not available and are largely anecdotal. Any PCD agent disposal facility will be of such visibility that a high level of regulatory oversight is ensured. Cancer risks at levels discussed in Sect. 4.9 are expected to be exceedingly low (10^{-5} for lifetime) and will therefore not contribute significantly to the health burden. To interpret 10^{-5}, if 100,000 people were exposed for 40 years as subsistence farmers who lived at the location of highest impact and grew all their foods there, one person might contract a fatal cancer. This is contrasted with approximately 25,000 cancer deaths anticipated due to natural causes."

K.3.6 Facility Closure, Decommissioning, and Potential Future Uses

K.3.6.1 Summary of comments

A few commenters asked for clarification in the DEIS about closure and decommissioning of the proposed facility and about the possibility that the facility could be used as a incinerator for hazardous and toxic wastes after the destruction of the Pueblo stockpile.

K.3.6.2 Responses to comments

FC-1. Originally, there was going to be decommissioning and closure but that law has been changed so that the state authorities can elect not to do that. The citizens and officials in Pueblo and Pueblo County ought to be fully aware that if this incineration process is put in here, they can be looking for incineration well beyond the mustard gas out there. They could be incinerating material from all over this country for decades.

Response. The Army intends to dismantle and close the Pueblo chemical agent disposal facility at completion of destruction activities. Through Public Law 99-145, Congress mandated destruction of the U.S. stockpile of chemical munitions as well as the dismantling and disposal of the destruction equipment upon completion. In a 1991 study, which was also mandated by Congress, the proposed incineration facilities were found to be not suited for many of the possible additional uses that were investigated. In 1999, Congress modified the law to give the individual states the “Right of First Refusal” in determining whether the chemical munitions facilities within their borders could be used for destruction of non-stockpile chemical materiel (NSCM). A subsequent study conducted by Mitretek Systems recommended that the PCD facility be used to destroy approximately one dozen NSCM items currently stored at PCD.

FC-2. (See DEIS, p. 3-11): Since the incinerators are designed specifically for the physical form and chemical characteristics of the expected incoming materials, how can they possibly be considered for post-destruction activities? How precisely do the incinerators have to be designed, to accommodate the various types of munitions? How well have the chemical characteristics of the expected incoming materials been qualified/quantified and how accurate does this have to be in order to design an adequate facility?

Response. The only post-destruction activity being considered is the destruction of a small quantity of mustard-filled bottles (about one dozen), which are not part of the chemical munitions stockpile, but are currently stored at PCD. The Army proposes to decommission and disassemble the proposed incinerator(s) after the non-stockpile materiel has been destroyed. No modifications would be necessary.

K.3.7 Human Health

K.3.7.1 Summary of comments

Human health issues were raised by a number of commenters. Several of the commenters were concerned about the health effects of dioxins, and some asked for an expanded analysis of the potential effects of PM-2.5 inhalation. Relatedly, some commenters asked about the types of monitoring that would be used and how it affects the analysis of potential human health risks. The analysis of human health effects in the DEIS was seen by some commenters as dismissive and incomplete. They asked that more details be included in the analysis, along with a more comprehensive use of relevant background and research material. Other commenters stated that existing environmental pollutants in the air and groundwater around the Pueblo area have contributed to significant health problems among residents and that the DEIS should evaluate potential impacts in light of those ongoing problems. As with other subject areas, a number of commenters indicated that “stating compliance with environmental regulations is not the same thing as disclosing environmental impacts.” Emissions and discharges within regulatory limits, the commenters noted, can still have human health effect. These commenters asked that compliance, risk, and impacts be clearly differentiated and explained in the DEIS. One commenter felt that the human health impact analysis should include a discussion of emergency preparedness facilities and activities. Two commenters disagreed with the choice of the inhalation pathway in the DEIS analysis and stated that other exposure pathways should be included (e.g., skin contact) or that the rationale for using only the inhalation pathway should be explained more convincingly. One commenter asked when and how site-specific health risk assessments will be conducted. Some commenters asked for clarification of the analytical methods and assumptions used in the DEIS, particularly for the derivation of injury and fatality estimates for the construction period.

K.3.7.2 Response to comments

HH-1. Appendix I, Table I.5 of the Draft EIS lists the sensitive population around the Pueblo Chemical Depot by age distribution. There are populations who are not covered by the age ranges listed but who are sensitive populations nevertheless. For example, people with respiratory problems, lupus, or MS are sensitive to environmental pollutants. The emissions from the incinerator may have adverse health effects on these sensitive populations. Also, the DEIS looks at lethal doses of chemicals but does not include effects that are less than fatal.

Response. The commenter has misunderstood the intent of the sensitivity analysis in Appendix I of the Draft EIS. That appendix analyzes the impacts of hypothetical accidents and attempts to determine the effect of varying human responses to exposure to accidentally released airborne mustard agent. It was not the intent of the analysis in Appendix I of the Draft EIS to address the types of sensitivity described in the comment. Although sublethal effects are acknowledged as possible, they would be difficult, if not impossible, to quantify for a large exposed population. Appendix I of the Draft EIS therefore focused only on potential fatalities from an accident.

We do not actually do any quantitative work with the different age groups for normal operations because we do not have the science behind different responses to the type of effluents we anticipate, with a few exceptions. However, the risk analyses conducted for this EIS include risk factors which are intentionally highly conservative in order to protect the entire population including sensitive persons.

The exhaust from the chemical munitions destruction processes, whether incineration or neutralization technologies are used, will be filtered and scrubbed to levels that should not present a hazard to sensitive populations, even when combined with emissions from other civilian activities within a 5–10 mile radius.

HH-2. The DEIS says, “Routine operations of a destruction facility and minor operational fluctuations might expose workers or the public to small below-standards quantities of hazardous materials.” In this community, we're not sure we trust the routine operations as the norm, or that minor operational fluctuations will be the only things that happen. Even if that were the case, what are the impacts of those hazardous materials; and are there other hazardous materials than those being regulated that one has to consider?

Response. In regard to emissions from the stack of either of the two incineration technologies, Sect. 4.7 of this FEIS has been revised to better explain the use of standards as metrics for impact assessment. Additionally, Sect. 4.9 has been revised to address the potential impacts from exposure to pollutants at concentrations below the permissible regulatory levels. A detailed evaluation of stack gas emissions is being prepared as part of a human health risk assessment for the facility, which is a required part of the RCRA permit for the facility.

HH-3. Emissions of CO_2 and PM-2.5, found in emissions of any incineration process, are considered in ACWA but not in PMCD. How much of the PM-2.5 gets into the alveoli of our own lungs? Please note that we have no monitor in Pueblo for PM-2.5. PM-2.5 can invade the alveoli of our lungs and cause various medical problems. According to the statistics available from the local state American Lung Association, Pueblo already has a higher than average percentage of children's asthma. This alone warrants the demand for PMCD to address CO_2 and PM-2.5.

Response. PM-2.5 was not a criteria pollutant at the time the analyses for the DEIS were prepared; however, as per a U.S. Supreme Court decision in February 2001, PM-2.5 is now a criteria pollutant. An assessment of PM-2.5, as well as CO_2 and the new 8-hour ozone standard (that will also become effective during the life of the proposed project) are presented in Sect. 4.7 of this FEIS. The American Lung Association data in the April 2001 report reveal that pediatric asthma rates in Pueblo County are essentially identical (to within 1%) of the state as a whole.

HH-4. An analysis of dioxin emissions in this document is sadly lacking. There are 75 kinds of dioxins, some of which are more dangerous than others when they're put into the air. Which kinds of dioxins will the incineration process emit? The dioxin emissions at JACADS were a surprise to the Army. How were dioxins monitored after they were discovered, and how are they monitored? The appendix treats the dioxin question in a very defensive manner. It includes a bibliography, but there are hundreds of articles not listed that provide evidence that dioxins are harmful for people and should be released in no quantities at all (e.g., the recent EPA Environmental Reassessment, which concludes that dioxins in no amount at all should be put into the air. Even a single molecule can be carcinogenic, yet the DEIS seems to assert that there is a safe level of dioxin emissions.

What is ignored is dioxin is persistent. It builds up in the soil, grass grows in that soil and absorbs them, the cattle who eat the grass absorb them, the humans who eat the cattle then are at risk of cancer. There is a ridiculous comparisons made of the amounts of dioxins that incineration would emit to wood burning stoves and a comparison to cigarettes. This could have been better stated: according to figures in the DEIS, incineration would have dioxin releases equivalent to that released by 100,893,000,000 cigarettes per year.

Response. The Army has reviewed the case of dioxins identified and measured in the JACADS tests and in the Tooele tests, emphasizing the little to no material found in the most hazardous 2,3,7,8-forms. The Army has also reviewed the EPA method for assigning relative hazard and the fact that the health risk assessments use dioxin data adjusted upwards to account for uncertainties between the measurements at JACADS and Tooele and the actual planned systems.

In addition, the Army has reviewed the non-chem-demil sources of dioxins and identified the typical urban concentrations measured in air and foodstuffs as a way to provide a basis for other text discussions. A discussion has been added to Sect. 4.9.3.2 of the FEIS regarding the current status of the EPA Dioxin Reassessment effort which should be coming to a conclusion shortly. There is currently no consensus within the EPA's Science Advisory Board that dioxins are human carcinogens.

Theoretically, under certain assumptions that are not biologically sound, single molecules can cause cancers but in laboratory tests, it is rather difficult to demonstrate. As a matter of record, the average human that gets cancer from smoking has inhaled a total of about 30 kg of cigarette smoke tars.

Sections 4.9.3.3 and 4.9.3.4 of the FEIS have been revised to expand the discussion of historical site-specific health risk analyses, including dioxins. The basis of the discussion is the measurements made at the two facilities where actual test burn data were obtained and how "safety factors" are used in the risk assessments to account for upset conditions. Dioxins and other products will be measured during the systemization of the chosen alternative, and operating permits will require demonstration of compliance with all applicable regulations.

HH-5. In the DEIS (p. 4-57), it is unclear why "estimates of dioxin exposure at PCD await the completion of design." Dioxin stack test data from mustard treatment at JACADS could be used for the incineration alternatives along with dioxin data collected by ACWA during the treatability testing for the neutralization/biotreatment and neutralization/SCWO alternatives. The FEIS should address dioxin exposures.

Response. Each incinerator facility/input feed will be somewhat unique, although quite similar. Section 4.9 has been revised to reiterate that the use of JACADS and Tooele burn data in the analysis provides the closest thing to what would actually occur during incinerator operations.

HH-6. The DEIS (p. 2-6) considers health effects resulting from inhalation only. Perhaps some discussion of other kinds of exposure to mustard gas is warranted.

In Table 4.22, the dioxin risk estimates from mustard incineration at JACADS presented in this table assumed only the direct inhalation pathway. Therefore, the risk estimate is incomplete. EPA guidance on conducting risk assessments strongly recommends that indirect exposure pathways be considered, especially when persistent bioaccumulative compounds such as dioxin are present.

Response. Sections 4.9.3.3 and 4.9.3.4 of this FEIS have been revised to be more explicit about the role of ingestion pathways and to enhance the analyses of previous site-specific assessments. Before operation of the destruction facility, the Army will perform a site-specific risk assessment, including food chain pathways.

HH-7. It is important for all to understand that to say significant impacts "are not expected" means nothing without context. By design, one hopes that such is the case. However catalogued experience of the unexpected should be included so as to discuss impacts for those possible unexpected events.

Response. Human health risk assessments have been conducted at other chemical demilitarization sites to assist the Army in managing the risks of destroying chemical weapons. Monitoring at JACADS and TOCDF has shown that despite some agent emissions, there have been no deleterious quantities of chemical agent extending off-site.

HH-8. In Table 4.19, the time-weighted average for HD is identical to the “technologically feasible real time detection limit.” While this monitoring is naturally important for immediately protecting workers' health, it is not clear whether preventive measures, such as ongoing monitoring, are in place to ensure workers are not exposed to HD.

Response. Continuous monitoring would be conducted under any alternative. See Sect. 4.26.

HH-9. In Table 3.2, there is no quantitative estimate of risk to human health for the incineration alternatives. “Less than 1 in 1 billion” is stated as the cancer risk for the neutralization technologies, but Table 4.24 lists risk from mustard only as “less than 1 in 1 million.” The FEIS should include quantitative estimates of risk using easily comparable terms.

Response. Table 4.24 shows that the EPA “level of concern” for cancer from exposure to mustard agent is 1×10^{-6} or one in one million and that estimates related to levels of emissions identified at JACADS are well below that. Table 3.2 illustrates that risks from mustard agent exposure during operations using any of the four alternatives are expected to be below the level of concern. Site-specific risk assessments have not been completed, but are being performed to comply with the RCRA license application process.

HH-10. The DEIS suggests (p. 4-50) that compliance with environmental regulations is the same thing as disclosing environmental impacts. The regulation or standard may be important in determining the significance of the impacts. However, there can still be substantial impacts (direct or cumulative) with complete compliance with environmental regulations. It should also be noted that not all environmental impacts are regulated.

Response. EPA regulations on pollutant emissions are based on extensive reviews of available toxicological research and are intended to be protective of human health. Substantial impacts are not anticipated to result from adherence with emission standards, although it is possible that changes in standards can occur over time. An EIS is not intended to challenge regulatory limits unless there are significant questions. At this time the Army analyst team has not identified any of these.

HH-11. Section ES.3.7 must discuss the impacts of releases and exposures, whether below standards or not. Of special concern in this largely agricultural area are the impacts on farmers and ranchers who consume their own crops and livestock and the implications for those who may consume those products distributed in commerce. When and how will the health risk assessment for incineration be conducted? Will a risk assessment be done for the neutralization technologies also?

Response. Evaluation of specific impacts awaits better definition of the technologies, which is occurring as this document is being prepared. At this point, there is actual experience with similar designs for the incinerator alternative but not for the neutralization options. Risk assessments have been completed for four incinerator facilities based on actual data from operating facilities. A review of these assessments, since the proposed incineration alternative is similar in most ways, provides the closest approximation to what might occur. Presentation of site-specific quantitative risks at this time would be clouded with many uncertainties that would further blur the distinction between alternatives without any ostensible benefit. Site-specific health risk assessments are being developed for incineration and non-incineration alternatives, and these assessments include the food chain pathways.

HH-12. ACWA DEIS addresses emergency response under human and health risks. The PMCD DEIS only addresses this issue under mitigation and monitoring. PMCD needs to properly address this issue under human and health risks as well. Regarding human and health risks and emergency response, the ACWA DEIS indicates that there is a Memorandum of Agreement with the Boone Volunteer Fire Department (BVFD) to provide emergency response assistance to PCD. There is no information to as to the training and qualifications BVFD has in dealing with the type of emergency that would most likely arise at the PCD and therefore it is impossible to determine if this assistance could be reasonably counted upon. There is no information regarding the TTC Fire Department and the Pueblo Rural Fire Department's training and qualifications as well. Regarding human and health risks, in the PMCD DEIS, the number of injuries listed during operation of the neutralization processes is listed as 82. But, in the ACWA DEIS, the number of injuries listed during operation of the neutralization processes is listed as 30. What is the reason for the discrepancy in these figures?

Response. It is not clear why emergency response should be addressed under routine operations. Emergency preparedness is addressed in Sect. 4.26.3 of this FEIS. The section has been revised to state that emergency preparedness activities would be the same for any of the alternatives for destruction of the PCD stockpile, as well as for continued storage. More detailed information is available through CSEPP and is not appropriate for the EIS.

HH-13. Section 4.9.2.1 calculates the estimated number of worker fatalities and injuries for construction of baseline and modified baseline facilities. If modified baseline is a pilot facility, then how do you arrive at these estimates? It is also stated in this section that the estimates were calculated from the Bureau of Labor Statistics, reported by the National Safety Council. Given the fact that estimates for both ACWA and PMCD used this same reference, why is there such a difference in the estimated injuries and fatalities?

Response. The modified baseline alternative is estimated to require about 75% of the human labor used for baseline. Other comparisons were made using data from different times in a developing design. Current estimates for neutralization alternatives are derived from the ACWA Technical Resource Document (May 2001).

HH-14. Construction at night would exceed the EPA-recommended noise level of 50 dB(A).

Response. The only construction activities that would occur at night would not generate sufficient noise levels to exceed the standard. Such activities include, for example, painting.

K.3.8 Socioeconomics and Infrastructure

K.3.8.1 Summary of comments

The primary socioeconomic concern for many commenters was the lack of an agricultural impact assessment in the DEIS. The commenters believe that the DEIS must assess potential impacts on agriculture because of the economic and social importance of agriculture in the region. Adverse effects of the proposed action on agriculture would have serious and far-reaching consequences beyond the immediate area of Pueblo, and the commenters indicated that the identification of a preferred technology cannot ignore potential impacts to agriculture. The agricultural assessment should include, they suggested, an evaluation of both short- and long-term effects, such as soil deposition concerns, impacts on livestock and crops, effects on agricultural workers, the potential for diminished marketability of agricultural products from the area, decreased water availability, and mitigation for any adverse impacts. Other socioeconomic issues cited by commenters primarily involved (1) effects of the proposed action on economic development in the Pueblo area (e.g., negative effects of perceived risk); (2) housing availability; (3) effect of State laws on project economics; (4) employment and in-migration; and (5) economic impact of accidents.

K.3.8.2 Response to comments

SOC-1. There has been no information available with regards to an agriculture assessment, and agriculture has been totally omitted from the DEISs. The Army must consider the physical and economic impact of both of the disposal technologies on the agriculture community in Pueblo and the neighboring counties. It must do everything possible to protect and insure the quality of area agricultural products.

Response. New text has been added to Sects. 4.9.3.3 and 4.9.3.4 in this FEIS to address the concern expressed in the comment about potential impacts to agriculture. The Army has initiated a detailed agricultural risk assessment around PCD to further investigate the types of impacts that might occur. This agricultural risk assessment would be required by Pueblo County as part of the requirements for the Certificate of Designation. Furthermore, regardless of which alternative is chosen, a detailed evaluation of stack gas emissions would be prepared as part of a human health risk assessment for the facility. This risk assessment is also a required part of the RCRA permit for the facility and would also address impacts to hypothetical subsistence farmers and to ecological resources around PCD.

SOC-2. There are relatively few professional jobs available here in Pueblo and Pueblo County compared to the rest of Colorado's Front Range communities. The clear choice is either of the alternative technologies of disposal which are the cleanest and safest. If anything less is chosen, the possibility of Pueblo attracting new business to provide professional jobs for its citizens will be gone.

Our primary concerns are as follows: incineration could well have a severe physical impact on the food chain, and on our primary agricultural resources of soil and water; secondly, incineration of blister agents would negatively impact the marketability of our products due to the public perception our area agricultural goods are unsafe.

Response. The concern expressed in the comment about jobs available in Pueblo and Pueblo County and the perceived potential for the incineration alternatives to harm agricultural business development is noted. However, no EIS can fully or accurately evaluate perceived impacts, such as the stigma described in the comment. The types of impacts described in the comment are beyond the scope of this EIS. An agricultural assessment will be conducted for the Certificate of Designation (Sect. 4.9.3.3) which is required prior to construction (see the response to Comment SOC-1).

Improvements to the existing on-post infrastructure (i.e., roads, water system, electricity, natural gas, communications, etc.), when combined with the eventual destruction of the chemical stockpile, could attract new business development to the PCD itself. This, in turn, could attract new off-post businesses to the area.

SOC-3. In the DEIS estimate of the employment created by the various technologies, modified baseline would create 734 jobs, and the neutralization/biodegradation process would create 1,616 jobs. Why are those numbers disparate, and were the numbers for the neutralization technologies acquired from the neutralization people?

Response. More recent information provided by the ACWA Technology Review Document (May 2001) brings the employment data into closer agreement. The FEIS has been revised to reflect more accurately the employment estimates.

SOC-4. When considering impacts, we are led to believe that the overall economic impact would be technologically neutral; however, there are impact fees available for incineration, yet there are not impact fees available for the ACWA option. This is neither neutral, or acceptable. Impact fees should be equitable regardless of the process used to destroy the mustard gas. Is the Army willing to level the playing field regarding the issue of impact fees across the board, whether it be incineration or the ACWA process?

Response. The Army would be responsible for paying all permit fees associated with operation of a munitions destruction facility. The equity issue raised in the comment would already be an integral part of the permit processes. It is not clear from the comment what specific impact fees are being referenced, therefore, no further response can be developed.

SOC-5. The Depot's electrical system is of critical importance to the Pueblo Depot Activity Development Authority. The chemical weapons destruction facility will effectively be a stand-alone user served via a new transmission line and substation. The Authority has been advised that excess power available at the new substation can be used in the industrial core area. However, no repairs or improvements to the existing core area transmission line or system will occur as part of the chemical weapons destruction program. Section 4.4.5 states that positive cumulative impact could result if the upgrades proposed for the existing electrical system would be implemented on a scale that would improve service to the entire PCP. Until PMCD is prepared to make the upgrades to the existing system, the EIS should not imply a positive environmental impact.

Response. At the specific request of the Pueblo Depot Activity Development Authority and the reuse community, the Army agreed to upgrade the new substation to a level that would facilitate its re-use. The new and upgraded substation should lead to beneficial impacts to the tenants at the depot, and to the community at large because it would provide the Authority and other organizations at the Depot with a valuable and dependable source of some electrical power as soon as it became operational, as well as use it in its entirety after the disposal mission has completed and moved-on. Any commitment to upgrade the core area electrical infrastructure would be collaboratively determined by the Authority, the reuse community, the Army, and other organizations involved in reuse plans and activities.

SOC-6. A separated grade interchange provides access to the PCD's Main Entrance Road from U.S. Highway 50. The interchange's on-ramps, off-ramps, highway overpass bridge, and railroad overpass bridge should undergo a thorough design and structural integrity evaluation. Additionally, the interchange's acceleration and deceleration lanes should undergo a design evaluation. The Authority concurs with Pueblo County's serious concerns as stated in Sect. 4.20.3.1, including "entrances to U.S. 50 from the interchange lack acceleration lanes and are extremely dangerous for entering traffic". As one who is counted among the "entering traffic" each workday, I assure the Army that this is very dangerous.

I have heard many premises to support the safety of the interchange. One premise is that it withstood the massive construction of PCD in the early 1940s; therefore, it will withstand the destruction facility's construction and operation. Nearly all PCD buildings were constructed using a different access road alignment, being from the North Avondale community—not this highway interchange. Daily traffic volume in and out of PCD is relatively light. A similar assumption was used to design the Pueblo Memorial Airport and Industrial Park interchange on the highway five miles to the west. After the Airport interchange was constructed, the real world discovered "rush hour". While daily traffic was relatively light, peak hour traffic caused congestion and safety problems. Today's trucks also have greater axle weight and length than their predecessors.

The Authority is concerned about the condition of the interchange at the end of the chemical weapons destruction program. Will it be in a condition at least as comparable as today? Or will it be worn and dilapidated? The future reuse of PCD is dependent on safe and convenient access.

Now is the time for the Army to evaluate the U.S. Highway 50 interchange and make such improvements as necessary to make it safe. A serious accident or bridge failure could result in both loss of life and curtailment of destruction operations. These events are foreseeable and preventable.

Response. PMCD has no jurisdiction over the interchange on-ramps, off-ramps, highway overpass bridge, railroad overpass bridge, acceleration and deceleration lanes. The interchange and associated roadways are under the jurisdiction of the County and the State. The PMCD is currently evaluating alternative routes to the PCD Main Entrance route for PUCDF construction and operational traffic. Depending on the specific route chosen, the length of road to be improved ranges from 5.4 miles to 6.7 miles and would extend from either Gate 2 or the northwest corner of the Depot boundary. The upgrade of additional roads beyond the initial access road to the proposed demilitarization site is currently being studied in addition to evaluating the pathways leading to PCD from an enhanced security posture. These will be addressed as part of the technology neutral infrastructure projects being completed prior to the technology decision.

SOC-7. The impact on housing is not merely a mathematical calculation, but is potentially life-changing to a segment of our community who otherwise has no contact with the chemical weapons destruction program. Those who (on the surface appear to) have the least contact may be the most impacted. When additional demand that is known to be short-term (versus perceived to be permanent) is injected into the housing market, the effect is not “trickle down”—it is “squeeze out.” The housing market will not respond to a short-term demand with increased supply (e.g., new construction). The existing housing market will be called upon to absorb the added demand. The housing market is layered or stratified, based on cost (rent or purchase). Unit type, size and location are factors that influence cost. The chemical weapons destruction program will inject short-term demand into the Pueblo region’s housing market. While there may be notable differences as to where in the stratification the injection occurs during the construction phase versus the operation phase, the result is the same.

Demand at the injection stratification level causes an increase in cost at this level and all levels of lower cost. Persons unable to financially compete in the now higher cost housing market will be displaced to a lower cost unit. If the housing market lacks a sufficient housing unit supply at the lower cost levels, the least financially competitive will become homeless—they will be “squeezed out” the bottom. These new homeless will make demands on the community’s social and mental health service systems (e.g., shelters, transitional housing). Many persons, albeit not homeless, will be squeezed to a lower cost housing unit and presumably a lower quality of life.

Is the housing supply sufficient in the Pueblo region to absorb the increased demand from the chemical weapons destruction facility? The Authority believes there is not a sufficient housing supply. Section 4.20.1 shows a projection of 4,300 vacant housing units in Pueblo County including 1,300 rental, based on estimated 1999 data. The Year 2000 Census reports a total of 4,347 vacant housing units, but 607 were “seasonal, recreational” such as mountain cabins that should not be considered part of the housing market. Actual Year 2000 vacancy, excluding seasonal and recreational units, is 3,700 units. The rental vacancy rate for the first quarter of Year 2001 is 5.7% according to a detailed survey by the Colorado Department of Housing. However, the rate is not homogenous throughout the cost strata. The vacancy rate is generally less in the lower cost units, meaning the housing supply available to absorb those “squeezed” is less than the EIS states and their adverse impact will be more. This will also have greater impact on the social and mental health service resources of the community.

Response. Comments noted. As discussed in Sect. 4.20.4, some of the available housing in Pueblo County would be occupied by in-migrating operations workers. However, it is likely that these workers would occupy housing in the mid- to high-price range given the income levels associated with the various occupational groups that are likely to in-migrate. Thus, the impact on lower income housing during operations is likely to be minimal. During construction, the impact on the low-income housing market could be larger, with many of the in-migrating workers staying on a temporary basis and therefore being more likely to rent cheaper accommodations that otherwise might be available to low income families. However, as only about 4 to 6 percent of all vacant housing is likely to be occupied by construction workers in the peak year (see Sect. 4.20.3), the impact on the low-income housing market would be relatively small.

SOC-8. The location for tapping the existing gas line is no longer near the housing area. The tapping point is at the Gas Regulator Station located at the intersection of PCD's 11th Street at 5th Avenue.

Response. Section 2.3.2 has been revised to reflect this information.

SOC-9. The intimation that PMCD may build a new warehouse is beyond comprehension. The construction of a new 40,000 sq. ft. warehouse on an installation where 29 warehouses (2,950,000 sq. ft.) already exist is not a prudent expenditure. Most of PCD's warehouses are vacant, but can be made ready at a fraction of the cost of a new warehouse.

Response. The decision to renovate existing space or to construct a new warehouse is heavily influenced by the need to have warehousing space as near to the proposed destruction facility as possible. The immediate retrieval of parts and components is critical to the proposed action and would be disadvantaged by having a warehouse too distant from the destruction facility.

SOC-10. The EIS states the Army owns PCD. Mr. Steve Ditmeyer of the Federal Railroad Administration asserts that PCD is owned by the U.S. Federal government and not the Army.

Response. The commenter is correct. The Federal Government owns PCD, holding title to the property as "the United States." The Depot is operated by the Department of Defense, Department of the Army. The EIS has been revised to clarify this issue.

SOC-11. The EIS fails to consider the Town of Boone as one of the "closest population centers". Boone's corporate limits is about 1.5 miles southeast of PCD's southern boundary.

Response. Section 4.10.1 in this FEIS has been revised to reflect this comment.

SOC-12. The Sheriff's Department serves most areas of Pueblo County outside the City of Pueblo; however, the Sheriff does not serve the PCD. The listed fire departments serve only their respective town or district, leaving much of the unincorporated county without fire protection.

Response. Section 4.20.1 in this FEIS has been revised to reflect this comment.

SOC-13. The State of Colorado has two laws in place that could impact the economic issues outlined in the socioeconomic section of the DEIS— the Taxpayers Bill of Rights (TABOR) and the Gallagher amendment. TABOR is a constitutional amendment adopted in 1992 and places a limit on how much new revenue from all sources a taxing entity (city or county) may collect from year to year. Unless a vote of the people is taken, any dollars collected beyond the percent allowed must be returned to the taxpayers. This limits the amount of new money that can be spent on infrastructure projects. The Gallagher amendment places the burden of school finance on the business community and the property tax paid by businesses. However, the Army does not pay sales or property taxes, but presumably the contractors would pay both of these taxes.

Response. In Colorado, sales of building materials for construction work on property owned by the U.S. government are exempt by statute from state sales taxes if they become part of the structure, highway, road, street, or other public works owned and used by the U.S. government. Also, electricity and most fuels consumed in performing real property construction are exempt. The purchase or rental of equipment, supplies, or other materials by the contractor, however, is taxable.

The additional sales and use taxes collected by the state of Colorado during construction would not likely be greater than the revenue collected if the contractors performed construction for privately-owned facilities. The impact of a chemical demilitarization facility on the Taxpayers Bill of Rights (TABOR) rebate calculation would, therefore, likely be smaller than that for a non-government owned facility.

The United States government does not pay Colorado income taxes. However, the additional income paid by the federal government to contractors during construction would impact the total income tax revenues collected by the state of Colorado and may affect the rebate calculation under TABOR.

Since the federal government is not subject to Colorado property taxes, additional construction on federal property would not change the ratio between residential and non-residential assessed values; therefore, no adjustment to property taxes would be required under the Gallagher amendment.

SOC-14. The Institute for Defense Analysis recently visited the Pueblo area and informed elected officials that only about 10% of the overall project costs will be spent in Pueblo. If this is an accurate statement, the socioeconomic impacts in the DEIS documents do not reflect this number and leave the impression that a significantly higher amount will be spent in the area.

Response. Estimates of the share of overall project spending flowing into the local economy take into account the industrial sectors in which project construction expenditures are likely to occur, the share of material expenditures in these sectors, and current unemployment rates in the local economy. Using this method, the analysis found that about 10 percent of construction material expenditures flowed into the local economy at Pueblo. Appendix J has been added to the FEIS to provide more detail on the estimating procedures used in this analysis.

SOC-15. In-migration should be divided between those who will bring their families to the community and stay for the duration of the project and transient workers who will be in the community for a short time and leave their families at a permanent residence, possible in another state. Those individuals who will be in Pueblo for the duration of the project will have a greater impact, both positive and negative, on the community than transient workers. Transient workers tend to live in mobile homes or apartments, buy very little besides food (not taxed in Colorado), and send the majority of their paycheck to their family that lives elsewhere. In addition, do the in-migration numbers include entire families or just workers?

Response. As it is not known precisely how long any given group of construction occupations would stay in the local area, it is difficult to estimate the number of in-migrating workers that would be accompanied by their families. To provide a conservative estimate of impacts, our analysis assumes that all in-migrating workers would bring families, with one school-aged child per family. Given those assumptions, impacts are projected for the peak construction year and the first year of operations.

SOC-16. The numbers used to reflect indirect jobs as a result of direct employment appear to be inflated. A 7% multiplier factor is a very high factor to use. A 3–4% factor would be more reasonable. If the number of people employed at the Depot consists mostly of local hires, the indirect employment will be lower, since presumably, these individuals are already employed and thus creating indirect employment.

Response. The analysis is based on the IMPLAN dataset for Pueblo County, together with estimates of local spending flowing into individual local sectors and expenditures associated with wages and salaries, to estimate indirect impacts. The calculation of indirect effects does not depend on the size of the direct employment impact, only on the overall level of expenditures associated with spending in each sector and with wage and salary spending. Appendix J provides more detail on the estimation procedures used in the analysis.

SOC-17. The documents fail to recognize the impacts of the Davis/Bacon wage on the worker and the median income and also fail to look at the cumulative impacts of increased costs of construction off-post.

Response. Although estimates of project cost and the consequent local economic impacts assume that Davis-Bacon wages are paid to the construction workers, the short-lived nature of project construction is not likely to have a long-term effect on local wages or construction costs in the Pueblo area. Compared to the overall level of employment and income in the Pueblo area and the highly sector-specific and limited nature of material procurement, construction of a chemical demilitarization facility is not likely to draw a significant number of workers from other construction or industrial projects. Cumulative impacts on off-post construction costs are therefore likely to be minimal.

SOC-18. The Pueblo Depot Activity Development Authority also signed the programmatic agreement concerning historic structures at the Depot.

Response. Section 4.19 in this FEIS has been revised to address this comment.

SOC-19. The Pueblo Mental Health Institute should not be included as a hospital that serves the Pueblo community for purposes of health needs. The Pueblo Mental Health Institute is a state-operated facility that deals only with mental health patients and has not been included in any preparations to handle accidents at the Depot.

Response. Section 4.20.1 in this FEIS has been revised to address this comment.

SOC-20. Section 4.20.1 should make clear that the Pueblo Sheriff does not serve the Depot.

Response. Section 4.20.1 in this FEIS has been revised to address this comment.

SOC-21. On p. 4-144, where does the number for the additional revenues to Pueblo County come from? This is a very high number in light of the information provided by the Institute for Defense Analysis. This is a reasonable number if most of the project dollars are spent in Pueblo.

Response. Section 4.20.3.1 indicates that the revenue figures come from a report published in October 1999 by Pueblo County, "Pueblo Chemical Depot Demilitarization Facility Economic Impact Study."

SOC-22. The sections on population and employment appear to be saying different things. The population section indicates a number of 508 for in-migration, while the employment section indicates that most of the 983 jobs created would be filled by local hires.

Response. The confusing text referenced in the comment has been revised throughout Sects. 4.20.3 and 4.20.4 in this FEIS.

SOC-23. In Sect. 4.20.4.1, the figures given in the section on public finances do not agree with the figures on page 4-144.

Response. The public finances figure cited on DEIS p. 4-144 is for facility construction, while the figure cited on p. 4-148 is for facility operation.

SOC-24. The DEIS is unclear regarding the number of in-migration workers and transient workers and how many workers could be hired locally. Definitions in- migration workers and transient workers should be clear in the EIS.

Response. The analysis assumes that some workers would not be hired locally and would in-migrate to the area during construction and operations. Because it is not known whether there would be sufficient employment opportunities for these in-migrants once construction and operations are completed, we assume that the in-migrants would be added to the existing population only during construction and operations.

The estimates of the number of workers who would in-migrate take into account the various occupations likely to be required, the number of workers in the local labor market currently in those occupations, and current local unemployment rates. Because of the highly specialized nature of the facility reflected in the specialized functions that would be required during both construction and operations, a certain proportion of managerial, engineering, and technical occupations would likely be filled from outside the area. Appendix J provides more detail on the estimation procedures used in the analysis.

K.3.9 Technology Issues

K.3.9.1 Summary of comments

Several commenters offered both general and specific comments and questions about the technical aspects of the alternatives. These include, for example, questions about puncturing the munitions, off-normal events such as a loss of power, the modes of transportation for process-related materials, and the disposition and handling of energetics and explosive compounds. Some commenters asked for more detail or clarity regarding utility requirements, and some asked about the exact nature of pilot-scale versus full-scale facilities. In addition, several commenters asked for additional detail regarding the type and results of testing performed for the agent destruction technologies (e.g., at JACADS); and a few commenters requested more information about the assumptions and plans associated with potential upgrades to existing infrastructure.

K.3.9.2 Response to comments

TI-1. In the Draft EIS, there is no information for modified baseline incineration regarding verifying that the munitions bodies have been properly punctured and what happens in the event that a shell is punctured but somehow gets plugged and is fed into the incinerator.

Response. Approximately 43,000 mustard-filled munitions were incinerated in the Metal Parts Furnace (MPF) at JACADS without a plugging problem. PMCD proposes to access the agent cavity by pushing the adapter at the top of the shell into the munition body. A hydraulic ram would be used to fracture the fuze adapter and buckle the burster well, creating a vent path in the munition for the agent to volatilize in the furnace. The length of the stroke of the ram determines how far the fractured part of the fuze adapter is pushed into the agent cavity, and the amount of buckling the burster well exhibits.

To determine that the cavity has been accessed and the fuze adapter is pressed into the munition a sufficient distance, sensors would monitor the stroke of the hydraulic ram. The control logic would not allow the munition to proceed to the next step until the sensors indicate that the ram has traveled full stroke. After the ram has retracted from the munition, another sensor would verify that the ram is still intact. Both the "full stroke" and the "sensor intact" signals would be sent to the control system and, if correct, would allow the munition to be loaded into the MPF tray for incineration. Sensor logic and wiring installation would prevent proceeding forward with lack of signal or sensor failure conditions. Also, closed-circuit television cameras would provide for secondary visual verification by the operator to check that the ram is intact, in case there is an equipment malfunction. The fuze adapter would be pressed sufficiently into the agent cavity to prevent the possibility of blocking the munition opening during furnace processing.

TI-2. In public discussions, the event where the loss of power would occur and the emergency generators would fail to go on has been characterized as impossible. This is very misleading, since such an event has already occurred at Tooele. In which case, the public should be made aware of the possibility of such an event and its impacts and that data should be included in the FEIS.

Response. Such events at JACADS and Tooele have been incorporated into Army planning and fully documented by the Army's Lessons Learned Program. There are a number of design features, both inherent and engineered, that control the risk associated with a complete loss of plant electrical power. These are considered and quantified in the risk assessments performed for all conceptual design features.

The system consequences of loss of power are the shutdown of all plant systems. In general, this simply results in the stopping of the process in a stable, safe configuration. There are two plant systems of primary concern during this scenario:

- shutdown of the MPF, where agent can continue to be volatilized and
- shutdown of heating, ventilating, and air conditioning (HVAC) systems, where pressure differentials between agent areas and non-agent areas cannot be maintained.

With regard to the MPF, the MPF Process System Hazard Analysis has evaluated this issue. The analysis concludes that the step one and total shutdown procedures for MPF furnace system would be adequate to address this situation. When commercial power loss occurs, the step one shutdown procedure would be initiated. This procedure involves start-up of the emergency generator. If the emergency generator failed to start, then the total shutdown procedure would be initiated. Under the total shutdown procedure, all the burners would be off, but stored instrument air would be supplied to the afterburner to maintain slightly oxidizing conditions in the afterburner to burn the agent. This approach would maintain temperature in the afterburner above 1400°F for some time. Under these conditions, the emergency water supply would be used to cool gases. If the temperatures in the primary chamber or the afterburner fell below safe levels, then the furnace primary chamber would be cooled down by water sprays to arrest agent volatilization. After sufficient cooling, the tray would be reversed back into the munition corridor. Considerably reduced combustion air flow from instrument air supply and draft from the stack would minimize positive pressure in the furnace. All these design features substantially reduce the probability that a total loss of all power would result in a release. In addition, the emergency generators can be started manually. During the loss-of-power event noted in the comment, the generators were started manually within about 12 minutes.

Total loss of HVAC would result in pressure equalization throughout the building, which would lead to agent migration into areas where agent would not normally be present. This scenario has also been studied in detail. Because of a lack of energy to push the agent great distances, it has been shown that the amount of agent migration would be small. Again, even the amount of migration possible does not happen instantaneously, so recovery of power can prevent even these small releases.

These scenarios have been modeled in detail in risk assessments of the baseline incineration facilities. The risk to the public from these scenarios has been determined to be orders of magnitude smaller than the scenarios that dominate the risk, primarily because (1) the releases would be too small to yield off-site concentrations sufficient to cause health effects to the public and (2) the probability of a total loss of power resulting in any off-site release is quite low.

The risk assessments have identified such scenarios as a measurable worker risk, since the localized nature of the releases could affect workers in the vicinity. However, the very low probability of such releases occurring results in these scenarios being a very minor contributor to total worker risk. As a result, it is reasonable to state that the probability of simultaneous loss of off-site power and emergency power, and an extended time period in which neither is recovered is so small as to be considered not a credible threat to health and safety.

TI-3. What are the primary modes of transportation of construction materials and wastes? What training and protection will be made available for workers?

Response. Construction materials would be delivered to the site primarily by semi-trucks, dump trucks, and concrete trucks. Non-hazardous construction waste (e.g., wood, metals, and paper) would be collected in roll on/off dumpsters and transported offsite to a nearby landfill. Hazardous construction waste (e.g., excess paint, oils, paint thinner) would be collected, separated, stored, and disposed of per EPA and State regulations. Any waste from portable toilets would be handled through a local vendor and transported offsite to a sewage treatment facility.

In addition to standard OSHA and Corps of Engineers construction safety training, workers would be trained in the identification, handling, and disposal of all construction wastes and would be provided the necessary personnel protective equipment. Protective masks would be required for any work inside the Chemical Munitions Storage Area A. Along with the protective mask training while in the CLA, workers would be given standard training in handling construction materials, including familiarization with Material Safety Data Sheets (MSDS) for hazardous materials and training on warning signals and evacuation procedures for the general construction area. No unusual construction hazards which are not typical for a heavy industrial construction building site are anticipated.

TI-4. What is “reconfiguration” and is that discussed in this document?

Response. Reconfiguration, which is the removal of the energetic components such as fuzes and bursters from the munitions, is explained in detail in Appendix D, Sect. D.1.3.1.1. The specific activities required for each munition type in the PCD inventory are given in Appendix D.

TI-5. The alternatives analysis should evaluate the impacts of explosive compounds and energetics treatment and/or disposal. Currently, most alternatives include both on- and off-site treatment/disposal without examining the potential environmental impacts of the on-site treatment, and off-site treatment and disposal. Further elaboration is needed, as the handling of explosives can be a significant process difficulty and may change environmental impacts.

Response. Several methods are being evaluated for the destruction of energetic components at PCD. Currently, uncontaminated energetics would be shipped off-site for disposal at a permitted TSDF, such as the Hawthorne Army Ammunition Plant, Nevada.
Agent-contaminated energetics would be destroyed on-site using either a blast chamber or a

deactivation furnace. A decision regarding the use of a blast chamber, such as the Donovan Chamber, or a deactivation furnace system is expected to be made after all evaluations are completed.

For all the proposed technologies, explosive compounds will be handled according to relevant Army and OSHA regulations. A description of the relevant waste management regulations has been added to Sect. 4.6 in this FEIS.

TI-6. (a) In Table 3.1, what are the references for the annual input requirements listed on this table? (b) Why is the electric power required for the neutralization technologies so much greater than for the incineration technologies? (c) What are the contingencies in the event of power outages and what are the expected frequency and duration of these outages? (d) Fuel oil is included under Table 3.1 but not Table 3.2, why? Is the fuel oil requirement needed for the incineration alternatives (Sect. 3.3.3.3) due to insurance/reliability needs? (e) Table 3.1 also does not compare well to Table 4.2, where the baseline incineration requirements are nearly double the modified incineration requirements and more than four times the requirements for neutralization alternatives. (f) Since cost can be a common factor in comparing power requirements, the question that could be answered in a summary table is, "What is the cost for the power requirements for each of the technologies compared?"

Response. (a) The data for the neutralization technologies were obtained from the ACWA Technology Resource Document (2001), and data for the incineration technologies were taken from the PMCD report on modified incineration (2000). (b) The neutralization alternatives have greater electrical heating requirements, while natural gas is the principal heat source for incineration. (c) The expected frequency and duration of electrical power outages are not currently available. Also see the response to Comment TI-2 regarding system responses to power outages. (d) Fuel oil is used mainly as fuel for the emergency generators. Differences in fuel oil consumption were not considered to be significant for decision making in this instance.
(e) Discrepancies between Table 3.1 and 4.2 have been corrected in this FEIS. (f) The provision of cost information and its role in the decision making process are addressed in the response to Comment AD-3.

TI-7. The modified baseline system is not yet designed. It is supposedly an improvement over baseline and ostensibly has been in use. However, only some of the unit processes have very limited experience, and these have not taken place with the oversight and scrutiny that the alternative technologies have had. Why are you unwilling to subject this technology, incineration, to the same kind of careful staged introduction and testing that the ACWA technologies have been subject to? Modified baseline models a theory and has not been tested.

Response. Modified baseline incineration would employ a metal parts furnace (MPF) to destroy the previously frozen mustard agent within the munition bodies in which it is currently stored. The MPF was used at JACADS for decontamination of the munition bodies after the chemical agent had been removed, and is currently being so used at Tooele, Utah. Destruction of the complete JACADS chemical munitions stockpile was completed by incineration in 2000. Additionally, a test was completed at JACADS in which about 43,000 munitions containing mustard agent were successfully destroyed using the method proposed for Pueblo. Both JACADS regular operations and the mustard agent test were conducted with full oversight by the EPA, and substantial data were obtained which support the alternative of incinerating mustard agent from the munition bodies with the MPF. The ACWA alternatives have not yet been tested at full scale. Another EIS is under preparation by ACWA for determining whether pilot testing neut/SCWO or neut/bio is feasible at Pueblo.

TI-8. The statement (on p. 1-6, line 5) that “a pilot test facility would be constructed and operated prior to full-scale stockpile destruction operations” is inconsistent with line 10 which states that the pilot test facility would completely destroy the stockpile within three years without the construction of additional facilities.

Response. According to ACWA, the pilot test facility would be built to a scale that is capable of destroying the entire stockpile in three years, once sufficient successful pilot testing has been completed.

TI-9. The site-specific DEIS does not refer to a pilot facility for the modified incineration technology, but indicates that a full-scale facility will be built. This appears to be in conflict with the Notice of Intent (NOI) that specifically states that a pilot facility will be built for all technologies with the exception of the baseline incineration technology.

In the PMCD DEIS it indicates that baseline is a demonstrated destruction process and therefore, the modifications done for the Pueblo site would not be new technology. This statement is misleading since one of the key aspects of the modified version is that the frozen chemical agent would be fed into the incinerator while it is still inside the munitions body. This key aspect of the process has not been properly tested and therefore should be characterized as an undemonstrated process. Modified baseline should be characterized as a pilot project and not as a demonstrated destruction process.

Additionally, trial bums would need to be conducted of the modified baseline incineration. Again, this should characterize modified baseline as a pilot project and not as a demonstrated destruction process.

Response. See the response to Comment TI-2 regarding the effectiveness and safety of using the MPF to incinerate mustard agent. If constructed at PCD, the modified baseline incineration facility would undergo strenuous individual process and full-system tests with non-chemical agent surrogates and with low throughput of chemical munitions prior to initiation of full-scale operation.

It should be noted that NEPA is a continuing process; and the Notice of Intent, as an early element of that process, referred to the modified baseline as a pilot program. However, the process is designed to revise and refine options, and the draft EIS appropriately identified modified baseline as a full-scale technology. Modified baseline would be a follow-on facility, as Tooele was a follow-on from JACADS. Similarly, Anniston, Umatilla, Pine Bluff, and Pueblo are incorporating lessons learned for their respective stockpiles. Therefore, the modified baseline facility is no longer regarded as a pilot program.

TI-10. On p. 2-15, line 23: The projected “receipt of environmental permits” by September 2002 for the incineration alternatives does not appear realistic, given that the Army does not plan to issue a ROD on this EIS until December 2001.

Response. As of the end of October 2001, the projected date for a technology decision, immediately followed by submission of permit applications to CDPHE, is the second quarter of Fiscal Year 2002, with expectations for receipt of approvals/permit during the second quarter of Fiscal Year 2003. Based on an excellent working relationship already in place with the CDPHE through the environmental WIPT process, this timeframe, although aggressive, is considered to be achievable.

TI-11. Why would PMCD choose baseline incineration or modified baseline incineration for Pueblo, which has mustard gas weapons when it determined that neutralization-biotreatment was the superior technology for destroying mustard gas stored at the Aberdeen Proving Grounds? How does a different application—that is, mustard gas in a weapon or projectile—potentially tip the balance of safest and best technology away from the neutralization-biotreatment technology?

Response. Prior to Congressional establishment of ACWA, the PMCD made the decision to test two neutralization technologies (neut/SCWO and neut/bio) for destruction of chemical agent. Aberdeen stores only bulk mustard agent in tanks called ton containers (no munitions or energetics). Because neutralization followed by biotreatment was believed to hold greater promise for destroying mustard than for other chemical agents, the decision was made to test neut/bio at Aberdeen. Similarly, a neut/SCWO facility is under construction at Newport, Indiana which stores only VX in ton containers.

TI-12. Several units, similar to those envisioned for parts of this new system, were used at JACADS to process a small number of munitions, and it is our understanding that air emissions from this exercise failed to meet air quality standards. No independent oversight mechanism of the sort used very successfully by the ACWA program was employed to verify the design and effectiveness of, the demonstration effort. The modified baseline system is far and away the most immature of the options under consideration for Pueblo. Tests at JACADS were certainly not tests of the “key elements” of the modified incineration process, and were not successful. Mercury emissions, for example, were high above the acceptable standard.

Response. See the response to Comment TI-2. At JACADS, both regular operations and the mustard agent test were conducted with full oversight by the EPA. Of the chemicals of concern, only mercury was determined to be near the emissions standards. Mercury did exceed the standard even though it was not detected in feed samples; thus, it is suspected to a be contaminant. The Army is studying both improvements in the PAS/PFS design (e.g., sulfur-impregnated charcoal beds) and operational procedures to reduce the emission rate to below the standard. A modified incineration facility will be required to meet the standards which have been promulgated by EPA and the State of Colorado to protect human health and the environment in order to be permitted to operate.

TI-13. Have tests of frozen munitions been conducted? Were the munitions really frozen at JACADS, as mentioned? How many? What kind?

Response. During the JACADS mustard campaign, some munitions could not be processed at the projectile mortar demil machine and were considered rejects. These reject munitions were processed by first freezing the munition to avoid extensive contamination and then cutting the top of the projectile to access the agent cavity. These reject munitions included 109 M104 155-mm projectiles, 2 M110 155-mm projectiles, 44 4.2-in. mortars, and 46 105-mm projectiles. Freezing the munitions was effective in eliminating frothing of the agent and the spread of agent contamination. These munitions were partially thawed to allow removal of the burster well prior to processing in the MPF. Additional testing and modeling are being performed as part of the Pueblo design effort to demonstrate that frozen munitions can be effectively processed through the MPF. Burner placement and operational parameters for the MPF when processing frozen rounds would be determined based on this testing.

TI-14. The DEIS states (p. 3-9) that "a single-story facility could be built more rapidly and inexpensively than a two-story facility required for baseline incineration." Details are required, along with a comparison with other options.

Response. There would be less concrete, reinforced steel, and formwork in the single-story facility. In addition, there would be two fewer incinerators to install. Generally, the size and complexity, and thus the cost and time, required would be reduced.

TI-15. On p. 3-9, much more detail is required. Impacts of various options must be discussed. How will frozen munitions be cut open?

Response. A soon to be published study describes the hardware, procedures, results, and conclusions of testing conducted on four methods of agent access for modified incineration: (1) press the fuse adaptor into the agent cavity, (2) punch a hole in the ogive, (3) flycut the interior of the burster well, and (4) offset mill the adaptor. Of these, the first has shown the most promise to date.

TI-16. In several places, the DEIS indicates that "more information will be provided as the facility design becomes more complete." These statements are far more applicable to the modified incineration system than to either of the neutralization systems, but similar language does not appear in the modified incineration discussion. This is unfortunate evidence of bias in favor of incineration on the part of the drafters.

Response. Between JACADS and TOCDF, the Army has a combined experience of more than 15 years in safely destroying the stockpile of chemical weapons using the baseline incineration method. Modified baseline is a simplification of the baseline process based on lessons learned in destruction of mustard-filled munitions at JACADS (see the response to Comment TI-2). A neutralization plant has not yet undergone such full-scale operations. Furthermore, a citeable design document for neutralization was published in May 2001, the same month as the DEIS.

TI-17. What are the laboratory wastes referred to in the DEIS? Is there, or will there be, a laboratory on site?

Response. There will be a laboratory on-site. The tasks of the laboratory will include determining if the air monitors have detected mustard agent and determining the hazardous character of and mustard agent contamination in liquids and solids. The laboratory wastes would result from these detection and identification activities. The FEIS has been modified to explain the presence and purpose of the laboratory.

TI-18. Section 3.3.4 notes, “Both ACWA systems could hold and test ventilation air before releasing it through the pollution control processes.” It is not clear whether the pre-release testing is planned for a routine basis (every release) or whether it is an emergency response measure for special situations. Describe how the ventilation air from the ACWA systems will be held for testing prior to release.

Response. Technical details concerning the ACWA technologies are now available in the ACWA Technology Resource Document published in May 2001.

TI-19. In Sects. ES.2 and 3.3.2, it should be clarified that the proposed SWCO system does not include a step for draining the mustard agent. Instead, the munitions will be frozen and crushed after the fuzes and bursters have been removed.

Response. The suggested revisions have been incorporated in Sects. ES.3 and 3.3.2.

TI-20. The modified incineration technology appears to be the only technology that includes a step for freezing the agent within the munition. If this is effective in overcoming the “foaming” phenomenon, why is this step not incorporated into all destruction technologies? The inclusion of freezing only in modified incineration appears to create a bias towards the modified incineration technology. Is the electrical supply demand of the freezing step included in the calculation of input requirements (e.g., Table 3.1)?

Response. Section 3.3.2 has been revised for clarity regarding freezing of agent. Freezing is included in the electrical supply demand.

K.3.10 Terrestrial and Aquatic Ecological Resources

K.3.10.1 Summary of comments

A few commenters raised issues regarding terrestrial and aquatic ecology. One commenter saw inconsistencies in DEIS statements about threatened and endangered species. Another was concerned about the impacts of the proposed action on terrestrial ecosystems and agricultural crops in the area, and two commenters asked for an enhanced discussion of potential impacts to wetlands. Similarly, one commenter asked about the effect of the proposed action on aquifer recharge and any subsequent related effects on wetlands; and another recommended that running routes and utility corridors be sited to avoid impacts to wetlands. Two commenters asked that Boone and Haynes creeks be added to the DEIS discussion of aquatic ecology. One commenter mentioned that the recently completed Resource Management Plan ecological assessment for the PCD was not used as a source of information for the DEIS.

K.3.10.2 Response to comments

TAE-1. There are inconsistencies throughout the document on the presence of federally listed or endangered species known to occur at PCD.

Response. No federally listed threatened or endangered species are known to occur at PCD, including the federally listed threatened or endangered species mentioned in project-related correspondence with the Fish and Wildlife Service. That correspondence indicated that the threatened or endangered species mentioned "could occur at or visit" PCD. For the sake of completeness, Table 4.29 of the FEIS includes federally listed threatened or endangered species that could be present at PCD, as well as various species of concern to the State of Colorado and the Colorado Natural Heritage Program. Several of these species are discussed at various locations in the text, and their status is given. No inconsistencies could be located.

TAE-2. Neither the ACWA nor the PMCD DEIS mentions the recently completed INRMP ecological assessment for the PCD, which may have more recent and relevant data for the natural resources sections.

Response. The text in Sect. 4.15.1 of this FEIS has been updated to reflect the INRMP.

TAE-3. The DEIS discusses construction of running routes and utility corridors. We recommend selecting the routes and corridors which avoid impacts on nearby wetlands.

Response. Comment noted. Sect. 4.26.7 (Ecological Mitigation) has been revised to include the following mitigation measure: "Avoid adverse effects on wetlands by appropriate siting and construction of running routes and utility corridors."

TAE-4. Impacts to wetlands as a result of the removal of water from the aquifers could be more significant than realized. There appears to be a great deal of confusion concerning the recharging of the aquifers. Recharging of the aquifers in this part of the country is very slow due to high evaporation and minimal precipitation. There is no determination of how much water would have to be recharged into the aquifers in order to keep the wetlands and streams at their current level. While it is acknowledged that well levels, both on- and off-site, could also fall during the operation of a facility, no mention is made as to how the public that is dependent upon well water for personal and agricultural use would be compensated for their loss of water.

Response. The DEIS clearly states that most recharge of the terrace alluvial aquifer is by underflow from the north (Sect. 4.13.1.1). The most recent information (Rust 1998), moreover, indicates that this recharge is greater than previously thought—about 1200 acre-feet/year rather than the 400 to 900 acre-feet/year cited in the DEIS. This FEIS has been updated with this information. The few small wetlands and the stream reach that possibly would be slightly to moderately affected by groundwater withdrawals during operations would probably return to normal water levels within a year or two of project closure. Sect. 4.26.7 sets forth requirements for monitoring of wetland water levels and requires a plan to augment water supply to wetlands if necessary. Please also see Sects. 4.13.1.1; 4.13.1.2, and 4.18.4.1.

The EIS states (in Sect. 4.13.4.1) that no impacts would be expected to off-post water users.

TAE-5. In the discussion on aquatic habitats and fish, there is no mention of Boone and Haynes Creeks. Are there no aquatic species in these creeks? And are there any impacts to those creeks?

Response. The most recently available information indicates that fathead minnows and brassy minnows reside in Boone Creek Pond. The same species likely occur at least occasionally in Boone Creek proper when flow is present. No information on species present in Haynes Creek was found. A few aquatic and semiaquatic invertebrates and possibly two or three species of small fish species such as the fathead and brassy minnows may occur in Haynes Creek during periods of adequate flow. Sect. 4.16 in this FEIS has been revised to indicate the presence of fish in Boone Creek and the possible presence in Haynes Creek.

The discussion of impacts on area surface waters provided in Sects. 4.16.3 and 4.16.4 is principally concerned with Haynes and Boone creeks and associated ponds and impoundments. The two creeks are explicitly named in Sect. 4.16.3, but not in Sect. 4.16.4. The text of Sect. 4.16.4 has therefore been revised in this FEIS to explicitly identify the two creeks by name.

K.3.11 Waste Management and Use

K.3.11.1 Summary of comments

A number of comments were offered regarding waste management, with most comments asking for clear and specific estimates of the types, quantities, generation rates, composition, and disposition of the various solid and liquid waste streams associated with the proposed action. As with other subject areas, commenters asked that the information be presented in a format that allows an easier and unbiased comparison of the alternative actions. Other issues related to waste management included

- impact of the transportation of waste, including effects on local roadways;
- type and availability of off-site disposal facilities;
- hazardous waste;
- on-site storage at the waste transfer area;
- disposal of agent-contaminated waste;
- charcoal/carbon filter use and disposition; and
- the construction or expansion of evaporation lagoons for sanitary waste.

K.3.11.2 Response to comments

WM-1. There is an apparent discrepancy between the PMCD DEIS and the ACWA DEIS on wastes generated at the Pueblo Chemical Depot in 1999. PMCD Table 4.3 lists hazardous solids as 2,000 lb, while ACWA Table 6.4.1 lists hazardous solids as 12,200 lb.

Response. The FEIS has been modified using updated data from the ACWA Technical Resource Document (May 2001).

WM-2. In Table 4.5, the estimated total waste generated from baseline incineration and from modified baseline incineration are precisely the same.

Response. For many of the wastes from baseline and modified baseline incineration, the waste quantities would be the same because the inputs are identical. Some wastes, such as liquid brine, would be process dependent. A more detailed explanation of the sources and process dependence (whether baseline or modified baseline incineration has any influence) of the wastes is presented in Sect. 4.6.3.1 of this FEIS.

WM-3. Tables 4.5 and 4.7 should be combined. Currently, the reader cannot compare the generation of wastes from the four different technologies because the tables do not have the same units or breakdown of waste types. In particular, it would be useful to show the differences in the amount of waste from energetics.

Response. The data in Tables 4.5 and 4.7 in the Draft EIS have been combined in this FEIS. Where possible the same units and waste types have been presented. As with biomass, energetics are not a waste type for all the technologies.

WM-4. In Table 3.2, the liquid brine generation rates are the same for both baseline and modified incineration (14.45 million gallons). Given that the modified incineration system would have only one incinerator and therefore one PAS versus the three incinerators and PASs for baseline, why are the brine generation rates the same?

Table 3.2 indicates that 7.5 tons/year of solid and 2.5 tons/year of liquid hazardous wastes will be produced and disposed of in TSDF. However, there is currently no TSDF where these wastes can be disposed of. The table should state that these wastes would have to be stored on-site indefinitely.

Response. Table 3.2 of this FEIS has been corrected to show that the baseline incineration technology would produce roughly 16 million gallons of liquid brines, and the modified baseline incineration would produce roughly 14.5 million gallons of liquid brines. The table has also been modified to indicate the wastes stored on-site.

WM-5. The EISs do not provide enough information on the transportation of wastes from PCD. Issues such as managing brines and other hazardous chemicals shipped on local roads are important, especially to the agricultural community. One cannot determine from these documents which technology would have the highest demand on the local highways or what technology requires the greatest volume of hazardous waste to be transported onto or out of the PCD.

Response. There will be no hazardous wastes transported onto the PCD. Two composite tables have been included in Sect. 4.6.3 of this FEIS to detail the quantities of wastes, both construction and operation, to be removed from PCD, the transport modes, and the number of transporting vehicles.

WM-6. The DEIS states (p. 2-15) that “Brines would be transported off-site for destruction at a permitted facility.” It is unlikely that any brines will be sent off for destruction. Typically, brines are treated or disposed of at permitted facilities.

Response. Comment noted. It is the intent of the Army to transport the brines off-site for disposal at a permitted facility.

WM-7. Section 3.1.3.7 should describe the kinds of waste to be stored in the transfer area.

Response. Section 3.1.3.7 of this FEIS has been modified to state that no wastes are stored in the Waste Transfer Areaw. Because no wastes are stored there, no temporary storage permits are required.

WM-8. The DEIS states (p. 4-20) that hazardous wastes are stored at a number of locations on the PCD installation. Is not clear from this paragraph the types of hazardous wastes that are being stored, the length of storage, and the types of environmental impacts that may be present from storing hazardous wastes. The FEIS should provide more information on hazardous wastes present on the PCD installation.

Other hazardous wastes are expected to be generated since chemical warfare agents and chemical warfare munitions are listed hazardous wastes in Colorado. Thus, the munitions bodies, brine liquids, ash, and solid salts would be listed hazardous wastes since they are derived form the treatment of listed hazardous wastes.

Response. Section 4.6.1 of this FEIS has been revised to address the types of wastes, lengths of storage, and potential impacts from storage. Additional information concerning hazardous wastes has been included in Sect 4.6.3.1.

WM-9. Appendix D indicates (p. D-40) that wastes with residual mustard agent of <200 ppb will be considered to not be contaminated with residual agent. More information should be provided discussing the disposal of wastes above and below the 200-ppb limit. The environmental impacts of evaluating waste on the 200-ppb limit as well as the origins of this limit should also be included in the FEIS.

Response. The origin and potential environmental impacts arising from using the 200-ppb limit for mustard agent are discussed in Sect. D.2.12.2 of this FEIS.

WM-10. Section 4.25.6 should describe disposal of the wastes generated from closure and decommissioning. Is there a possibility of an on-site landfill? Could the wastes be treated or disposed of in the incinerator or neutralization technologies facilities?

Response. The Army does not plan to have an on-site landfill. However, an on-site landfill could be required if building demolition is required for closure. Assuming no building demolition is required, closure wastes will primarily be treated in the MPF to minimize the amount of waste that must be disposed of off-site. At JACADS, 318,000 lb of waste carbon, 300,000 lb of halogenated plastics, and a variety of other waste products achieve 99+% weight/volume reductions in the furnaces. The modified baseline PUCDF is being designed to minimize the amount of agent contamination and, as a consequence, minimize the amount of closure wastes that will be generated. Based on these steps, it is expected that the quantity of closure wastes will be less than that generated at the baseline facilities. For example, the modified baseline PUCDF design will include a freezing step that should virtually eliminate the probability of agent spills from a munition and reduce the agent vapor levels in process areas, thus reducing potential and actual contaminated areas and equipment items. In addition, munitions will not be drained. As a result, MDM, agent holding tanks, LIC, LIC PAS, and associated piping are not necessary. These components will not require decontamination during closure.

Closure wastes that would be generated at the Modified Baseline Facility consist of the following types:

- Wastes that are similar to operational wastes. These include wastes that are generated during closure when the furnaces are operated to treat operational secondary wastes or other closure wastes (maintenance wastes, tools, adsorbents, SDS, DPE, brine, spent carbon, used equipment, instrumentation, etc).
- Wastes from the decontamination and dismantlement of equipment and structures (including secondary wastes generated from these activities, such as SDS and DPE). These include debris wastes such as steel from conveyors; tanks; piping located in toxic areas; concrete from walls, floors, and ceilings of areas that may be potentially contaminated with agent; and SDS used to decontaminate equipment and structures, etc.

For agent-contaminated closure wastes, the preferred treatment method will be by on-site incineration. Since the MPF can treat most, if not all, types of materials expected to be present in the closure wastes (e.g., metals, concrete, stainless steel, plastics, and halogenated plastics), the MPF will be the primary treatment alternative for contaminated closure wastes. All closure wastes that are not contaminated or contaminated below exit levels can be disposed off at off-site TSDFs or landfills. The MPF components themselves can be considered 5X and can be disposed of off-site. The only components of the MPF charge system (conveyors and charge airlock) that are not exposed to 5X conditions can be treated in the MPF as well. Treatment of wastes that are generated during operations as well as closure will be treated similarly to operations. Certain wastes that are generated toward the tail end of closure (for example, the final batch of carbon, part of the HVAC) would need to be disposed at an off-site location.

Section 4.25.6 has been revised to describe the disposal of wastes generated from closure and decommissioning.

WM-11. The DEIS mentions (p. 3-13) that the ACWA systems would recycle their process liquids. Please clarify. Does this mean all process liquids; therefore there would be no liquid waste for ultimate disposal or further wastewater treatment?

Response. The ACWA Technical Resource Document (May 2001) states that all process liquids would be recycled.

WM-12. The DEIS discussion (pp. 4-18–4-26) of hazardous and non-hazardous wastes seems inconsistent between the incineration and the non-incineration alternatives. For incineration, spent charcoal filters for ventilation and PAS are categorized as hazardous waste. For neutralization facilities, spent carbon filters and carbon grit are listed as non-hazardous waste. Please check and clarify for consistency.

Response. The discussion of waste in this FEIS has been revised for consistency.

WM-13. The management of sanitary wastes during operations foresees the expansion of or the construction of new evaporative lagoons. If the lagoons are merely expanded there is no discussion about the current condition of the lagoons and whether they currently meet the local and state requirements for evaporative lagoons. In addition, in the site-specific DEIS there is no discussion of pre-treatment of the sanitary wastes prior to being put into the lagoons.

The ACWA DEIS (page 6-21) states that the existing lagoons might need to be expanded to handle sanitary wastes, while the site specific DEIS (page 3-23) says that sewage will be treated and sent to evaporative lagoons. The site-specific DEIS (p 4-87) states that the west lagoon was once in operation, but is now closed. Both DEIS's should address the use or addition of lagoons at PCD in a consistent manner.

Response. The DEIS states (p. 4-24), “Sewage from the destruction facility would be processed in a packaged treatment system with effluent directed to lined evaporative lagoons in close proximity to the destruction facility.” The DEIS also states (p. 4-26), “The sanitary wastewater would be processed in a packaged treatment system with effluent directed to lined evaporative lagoons in close proximity to the destruction facility.” Section 4.6.1 of this FEIS has been modified to discuss the current condition of the on-site evaporative lagoons.

The west lagoon system has not been in service for several years, but it is noted in the EIS for factual accuracy. The west lagoon system would not receive sewage from the destruction facility, and Sect. 4 has been revised for consistency and clarity.

WM-14. The discussion of brine salts (pp. 4-23–4-25) in the incineration technologies does not indicate the presence of heavy metals in the brine while there is an indication of heavy metals in the brine salts for the neutralization technologies. Is this an oversight or are the heavy metals in incineration a part of a different effluent?

Response. Experience at JACADS has shown that the incinerator ash is the primary recipient of heavy metals (cadmium, mercury, and lead). Occasionally the liquid brine has a sufficient concentration of lead (> 5 ppm) for it to be classified as a hazardous waste. Section 4.6.3 has been revised for clarity. The average concentration of metals in liquid brine from JACADS is shown in Table 4.9. If the volume of liquid were substantially reduced, as in brine drying, the increase in metals concentrations would likely make the brine salt a RCRA hazardous waste.

WM-15. There is no information or discussion on using contaminated water in the destruction process. This information could be helpful in determining if there would be an added benefit with each technology.

Response. The neutralization technologies would recycle their process water. The Army does not intend to use contaminated water.

WM-16. The DEIS states (p. 2-15) that “Construction and operation of a chemical munitions destruction facility using any of the technologies (incineration and neutralization) being considered for implementation at PCD would produce hazardous and non-hazardous solid and liquid wastes.” The statement is misleading. Construction and process waste streams should be described and dealt with separately. Process solid waste streams should be described in some detail with emphasis on hazardous constituents and the complexity and risks associated with any further treatment or containment required. It is our understanding that the neutralization-based systems produce no liquid process wastes until they are shut down and drained for decommissioning.

Response. Comment noted. Construction and process waste streams are described separately in Chapter 4 of this FEIS.

WM-17. Section 2.3.3 is inadequate. It seems to suggest that there is no significant difference between the waste streams produced by the available technologies. This section should describe the differences in general terms, should recognize that impacts occur even if facilities operate within regulatory limits all of the time, and should acknowledge that no facility operates within regulatory limits all of the time. Discussion in later chapters should discuss these matters in greater detail.

Construction and process waste streams should be described and dealt with separately. Process solid waste streams should be described in some detail with emphasis on hazardous constituents and the complexity and risks associated with any further treatment or containment required. It is our understanding that the neutralization-based systems produce no liquid process wastes until they are shut down and drained for decommissioning.

Response. Chapter 2 provides a general description of the proposed action which has as its basis destruction of the PCD chemical munitions stockpile. Analysis and comparison of impacts is presented in Chapter 4. Additional details and assessment concerning both hazardous and nonhazardous wastes resulting from each of the alternatives have been added to Sect. 4.6.

WM-18. The DEIS states (p. 3-8), “Prompted by operating difficulties encountered at JACADS and TOCDF, the incinerator designated for dunnage would be eliminated.” This requires explanation. What difficulties were encountered? What would replace the dunnage incinerator as the treatment method for dunnage? What would be the impacts?

Response. Sections 3.2.1 and 3.2.2 of the FEIS have been revised to explain the elimination of the dunnage incinerator (DUN) and the treatment of dunnage. Uncontaminated dunnage would be handled as waste to be disposed off-site. Contaminated dunnage would be treated via the MPF.

The DUN was operated at JACADS from mid 1989 to mid 1996, primarily to process the dunnage and, to a limited extent, to co-process wood and charcoal and other miscellaneous wastes in small quantities. In 1994, a trial burn test with GB agent and wood was conducted. The results of the trial burn verified that the DUN performed well within the RCRA-defined parameters. However, stable and reliable operations were difficult to sustain, and significant resources required to maintain the DUN.

DUN operations were eventually discontinued at JACADS primarily for economic reasons. Uncontaminated dunnage could be shipped off-site or reused for offsite transfer of demilitarized projectile casings. This approach is also being taken at TOCDF in Utah. The amount of contaminated dunnage generated at JACADS and TOCDF has been very small and can be treated in the MPF. The miscellaneous wastes that might be agent contaminated and were originally intended to be processed in the DUN would be treated in the MPF or DFS.

There is no DUN proposed for the modified baseline facility. As was done at JACADS and is being done at TOCDF, uncontaminated dunnage would be shipped offsite. Contaminated dunnage (small quantities only if experience at PUCDF parallels that at JACADS and TOCDF) and miscellaneous wastes that might be agent contaminated would be processed in the MPF. The details of dunnage characterization would be coordinated with the State of Colorado but are expected to be similar to TOCDF procedures. Approximately 10% of the MPF availability is currently scheduled for secondary waste treatment.

WM-19. The DEIS states (p. 3-8) that, ". . . to substantially reduce costs, liquid scrubber brines salts would not be dried, but would be shipped to an off-site TSDF in liquid form." This requires explanation. Evaporating water is not a complex industrial process. Why didn't the Brine Reduction Area methods work? What alternatives exist? Why was transportation to an injection well considered the best of the available options? (Cost is not the only relevant consideration.) The impacts of the alternatives must be described and discussed. For wastes transported offsite, likely destination sites, transportation methods and routes must be identified and the implications for health and environmental risks must be discussed and compared. For underground injection of contaminated brine, the ultimate environmental fate of contaminants must be discussed.

Response. Section 3.2.1 of the FEIS has been revised to explain why the Brine Reduction Area was eliminated and transportation to an off-site treatment/disposal facility was chosen.

At JACADS, reduction of the brine to salts became a major rate limiting step during the 4.2-in. HD mortar round campaign. The high metals content in the brine required that the brine be processed at a reduced rate in the BRA to ensure regulatory compliance. In addition, a greater quantity of brine was produced per lb of mustard destroyed. Each mortar round generated 8–12 gallons of brine. The feed rate limitation, coupled with the production of increased quantities of brine resulted in the BRA becoming the rate limiting system during the MPF shakedown period. In addition, operation and maintenance requirements for the BRA were extensive.

Because of these difficulties encountered at JACADS, a review of off-site disposal options versus construction and operation of a BRA was performed for the proposed PCD modified baseline incineration facility. If a BRA were to be implemented at Pueblo, the brine would likely require a pre-treatment step to remove heavy metals prior to treatment in the BRA. In addition, the resulting salts would have to be disposed of as a hazardous waste. Based on a cost analysis, it was determined that it would be more economical and efficient to ship the brine to a hazardous waste TSDF. This is also the approach that is currently being employed at TOCDF.

WM-20. The DEIS states (p. 3-12) that "Donovan Chambers are used routinely at some Army sites for destruction of conventional munitions. Detailed information about Donovan Chambers and their emissions are not available at this time." If Donovan Chambers are "used routinely" by the Army, why is detailed information is not available? Please explain. All options and their impacts must be discussed.

Response. Several methods are being evaluated for the on-site destruction of contaminated energetics: a blast chamber, a Donovan Chamber, and a DFS. A decision on the chosen destruction method is expected to be reached after all evaluations have been completed. Section 3.3.3.1 of this FEIS has been revised to clarify this issue.

WM-21. Please detail how it will be determined whether energetics and dunnage are contaminated or not.

Response. The energetics and dunnage would be sampled, and the samples would be tested for mustard agent in excess of 200 ppb. Text has been added to the FEIS to make this clear.

WM-22. The DEIS states (p. 3-13) that "The effluents from all the chemical munitions destruction alternatives would include gases and solids. The modified and baseline incineration systems would also have liquid effluents." We believe this to be an accurate statement, but it is inconsistent with assertions about liquid wastes in several other places in the PMCD document.

Response. Comment noted. The statement has been modified to clarify the treatment of liquid wastes.

WM-23. The DEIS states (p. 4-25) that the brine salts from the neutralization facilities "could contain significant amounts of toxic heavy metals (e.g., lead)." Are there any data to give a better prediction of these amounts? From experience and data at other sites? Does this mean that such heavy metals come from the mustard gas or the energetics or some other source? Do we understand that any heavy metals present would also be present if the method of destruction is baseline incineration and modified baseline incineration? Where would these heavy metals end up in either of the incineration methods? In the brine? In the filters? In the emissions? This is particularly important.

Response. See the response the Comment WM-14. Heavy metals are contained in the munitions and chemical agent; the heavy metals remain in the wastes after the organic compounds have been destroyed.

WM-24. The DEIS states, "If the hazardous brine salt failed the RCRA test, stabilization of the waste may be required for disposal." Just how might this stabilization occur? The ACWA DEIS states (p. 6-29), "a new facility might need to be constructed or an existing facility might need to be expanded to handle the solid salt waste." These statements alone cannot possibly be satisfactory for determining impacts as required by law. This requires more specificity.

Response. A new facility for brine salt treatment would be built near the proposed destruction site. The stabilization would likely take the form of grouting or encapsulation. The final decision would be made by ACWA prior to construction.

WM-25. Our concern with wastes is perhaps best focused on the statement: “The greatest potential for significant direct and cumulative impacts lies with the liquid brines.” We find the brine solutions resulting from the incineration technologies to be far more problematic than brine salts of the neutralization technologies. The volume is higher; transporting liquid carries more risk. The impact on all sites together is higher.

In addition, the presence of hazardous solid waste ash from the incineration technologies adds the risk for significant impact. From the perspective of wastes, the neutralization technologies appear to us to be preferable to the incineration technologies.

Response. Comment noted. Although brines are produced in the incineration process, the neutralization technologies produce large quantities of biomass [29% water (ACWA TRD 2001)] and/or brine salts [13% water, neutralization with SCWO, and 20% water, neutralization with biodegradation (ACWA TRD 2001)]. Any wastes to be shipped off-site would be transported only after they are determined to be agent-free; and they would be placarded and handled carefully and responsibly as hazardous wastes.

WM-26. The EIS needs to be updated to include the newly added listed waste codes of K901 (waste chemical weapons and residues resulting from treatment of hazardous wastes with the code P910 for mustard) and K902 (soil, water, debris, or containers contaminated through contact with waste chemical weapons listed as K901 or hazardous waste with code 910 for mustard), both of which were recently added to the Colorado Hazardous Waste Regulations (6 CCR 1007-3). For each alternative, the EIS should discuss the generation and management of wastes expected to carry these new listed waste codes.

Response. Text has been added to Sect. 4.6 concerning the Colorado newly listed waste codes.

WM-27. The EIS should discuss any agent degradation products of concern. For permitting purposes, a sampling, monitoring, and handling plan will need to be developed.

Response. Additional information concerning agent degradation products has been included in Sect. 4.6.3.1 of this FEIS.

WM-28. In Sect. 4.22.3, Waste Management, In the event of a spill, the issue is glossed over with a statement that simply says “plans and resources would be in place. . .” This statement is inadequate, and much more detail is required.

Response. Section 4.22.3 has been revised and updated in this FEIS to describe the depot's existing Chemical Agent/Incident Response and Assistance (CAIRA) plan. The CAIRA plan contains the details of the Depot's response to any spills of mustard agent at PCD.

K.3.12 Water Quality and Use

K.3.12.1 Summary of comments

Many commenters voiced concerns about water quality and use issues, particularly because of the sensitivity of water availability and water rights ("senior" and "junior") in the State of Colorado. These commenters stated that the DEIS needs an improved discussion of (1) the quantities of water used and recycled in each destruction technology and the relevant operations schedules, (2) the amount of water that will become hazardous waste, (3) the aquifer recharge rates, (4) the nature and extent of existing groundwater and surface water contamination and the potential contribution of the proposed action to further contamination, (5) testing and monitoring on- and off-site in wells and springs, (6) the measures that will be taken to preserve existing water quality, (7) groundwater flow rates and direction, (8) the explosives products plume in the southwest corner of PCD, and (9) the impact of the proposed action on current remediation and corrective actions.

K.3.12.2 Response to comments

WQ-1. The Depot has very limited water rights; therefore the Depot's water supply may not be reliable. The eleven Depot wells awarded water rights in Water Court Case 81CW196 are extremely "junior," meaning the ability to withdraw ground water through these wells is subject to an annually approved plan requiring the replacement or "augmentation" of the withdrawn water by water from another source. The Depot is a member of a groundwater replacement association that purchases water native to (falls within) the Arkansas River Basin. The purchase of replacement water is subject to the precipitation and a water owner's willingness to sell water in a given year. While the Army may be financially dominant in the water market and capable of "outbidding" other potential users, Mother Nature is not so easily swayed. The Army's operation of a chemical destruction facility at the Depot will be dependent upon precipitation.

Much of the Arkansas River Basin in Colorado is in a semi-arid region where low precipitation and drought are typical. State Division Water Engineer Steve Witte's 11/07/00 letter to the Depot's Support Directorate summarizes the potential impact most succinctly: "Should this area suffer from consecutive years of drought or semi-drought conditions the Depot, like other replacement association members, may be forced to curtail or ultimately totally cease pumping wells until replacement supplies once again become available."

The DEIS makes passing reference to the Depot's "junior" water rights in Sect. 6.3.3.1, and Sect. 6.3.3.3 suggests a solution to the water demand issue may be to purchase the right to extract additional water from more senior water rights holders. First, the Depot does not purchase the water rights—the purchase is made by the association. Second is the false presumption that owners of senior water rights will have water to sell.

The Authority has recommended the Depot secure a reliable water supply via a contract with the Pueblo Board of Water Works (BoWW) for the consumptive use of the BoWW's transmountain water. Water will continue to be withdrawn from the ground beneath the Depot using the Depot's well system. However, the water consumed by the Depot will be replaced in the Arkansas River Basin by foreign water, being water that falls outside the Arkansas River Basin and is imported by transfer over/through the mountains—hence "transmountain". Under the BoWW contract the Depot's water source is transformed from the drought-plagued Arkansas River Basin to the abundant waters of the western slope of the Colorado Rocky Mountains. A second major factor with BoWW transmountain water is the basis for payment. The Depot currently pays for the right to "pump" or withdraw a given quantity of water. Under the BoWW contract, the Depot would pay for the right to "consume" a given quantity of water.

Response. Correspondence from PCD supports the availability of sufficient water for chemical demilitarization destruction operations without the need for augmentation. However, before the proposed action is implemented, PCD would verify that it has the right to pump the water needed for operations. Groundwater at PCD is considered tributary to the Arkansas River. Accordingly, PCD would contact and work with the Division Engineer and other appropriate entities to determine how much water is available under its water rights and, if necessary, how to purchase additional water rights as needed. This would include filing an augmentation plan.

WQ-2. I understand that the water used for incineration will become hazardous waste and be transported off site and possibly be injected into a well in Texas. What happens to the water waste from the neutralization process?

Response. The fate of water waste from the neutralization technologies proposed for PCD has been updated in Sect. 4.6.3.3 of the FEIS based upon information provided from the ACWA Technical Resource Document, which states that there is no wastewater. Water from drying of the liquid brines would be evaporated to the atmosphere.

WQ-3. The neut bio will use 39 acre-feet of process water. The modified baseline will use 29 acre-feet of process water. Please describe the operation schedules that these numbers are based on; how many hours a week? How many weeks per year? And most importantly, how many years is neut bio reusing some of the same water. And if so, what then, is the consumptive use of the neut bio process?

Response. The quantities given for process water are for annual consumption. Neutralization with biotreatment would consume more than 39 acre-feet of water per year. The annual operating schedules for incineration and neutralization technologies are given in Sect. 3.4.1 of this FEIS. For modified incineration, the FEIS assumes an operating schedule of 24 hours per day, 7 days per week, 52 weeks per year. For neutralization with biotreatment, the FEIS assumes an operating schedule of 12 hours per shift, 6 days per week, 46 weeks per year. The ACWA Technical Resource Document (2001) indicates that neutralization with biotreatment would require an average of 47,000 gallons of process water per day and 13 million gallons annually; thus, about 34 million gallons would be required over the process lifetime.

WQ-4. We recently had an EPA Environmental Impact Study completed in Pueblo where actual samples were obtained to determine toxicity levels.

It seems as if many of the conclusions reached in the DEIS were based on outdated research material with no actual samples taken for this draft. Are there any plans to actually test each of the seven existing wells for specific water quality and flow rate or install an air quality monitor prior to construction activity; and if so, will this be part of the Final Environmental Impact Statement?

Response. A search of all EPA web pages was unable to identify this EPA Environmental Impact Study cited in the comment.

The most recently available information was used in the preparation of this DEIS. There are no plans to further test existing wells for water quality and flowrate prior to construction activity During operations, monitoring will be conducted as required by the state and federal regulatory agencies.

WQ-5. According to the groundwater studies done in the DEIS, the quantity of water in the aquifers will be restored quickly. And within two years of the process being complete, will the water equal and quantity be back to normal? Who will be affected by the temporary depletion of the aquifer?

Response. Because of (1) a groundwater inflow rate from the north of the PCD site of between 400 and 900 acre-feet/year, (2) an unknown quantity of infiltration from on-site precipitation and streams, and (3) cessation of groundwater withdrawals of up to 75 acre-feet/year for chemical destruction operations, it would be quite reasonable to expect recovery of both water quantity and quality in two years or less, unless other users increase withdrawals, or a severe drought should occur. Other competing users on the PCD site would possibly be affected by the temporary drawdown of the water table, but off-site users would be unlikely to be affected. Also see the response to Comment TAE-4.

WQ-6. What is the definition of standard precautions when referring to preserving the existing surface water? Is there a book of labor standards used to maintain the existing surface water?

Response. The phrase “standard precautions” has been changed to “best management and/or good engineering practices . . . as appropriate.” There is no one document governing the selection of BMPs, but a number of federal, state, and professional documents address the issue of prevention and mitigation of construction-related spills and stormwater runoff. Some of these include the following which have been included in the text of the FEIS.

- Colorado Department Of Public Health & Environment. 1996. *Guidance Document: Light And Heavy Industry Permits—Preparing A Stormwater Management Plan.* Water Quality Control Division.
- US Army Corps of Engineers (USACE). 1998. *Analysis of BMPs for Small Construction Sites.* Prepared for EPA Office of Wastewater Management.
- US EPA. 1996. *Protecting Natural Wetlands: A Guide to Stormwater Best Management Practices.* EPA-843-B-96-001. Washington, DC.
- US EPA. 1992. *Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices*. EPA 832-R-92-005. Washington, DC.
- US EPA. 1992. *Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices.* EPA 832-R-92-006. Washington, DC.
- US EPA. 1993. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.* EPA 840-B-92-002. Washington, DC.

WQ-7. Our concerns are with regard to the quality of the water, the quantity of the usage. We are concerned about the quality of the water after the completion of the proposed action. Some of the current problems that the Depot has had with regard to water problems have already had a negative backlash with us because some area residents question the quality of our water. Our water is supplied by the aquifer that runs under the Depot. The DEIS recognizes that the water used in the destruction will reduce the amount of water to users downgradient of the Depot, and that it will likely impact the quality of the water with regard to its mineral content. Our business may have to employ different means of filtration that are not currently necessary in order to ensure that we have a quality product for our customers. This would also be an additional expense for us. We also have concerns about the water that will be discharged after the process.

Response. PCD has monitored the supply springs at the southeast corner of PCD for explosives degradation products, metals, and numerous other contaminants for the last seven years. No indication of contamination has been observed.

There should be no project-related water withdrawals after cessation of operations, and no discharge of effluents either during operations (with the exception of treated sanitary water to evaporation lagoons), nor after operations cease (Sect. 4.25.3).

WQ-8. There are concerns about groundwater contamination near Boone. We have 17 to 19 active springs which supply water to our main water system in Boone, and this is supplemented by our main water supply from the field water supply. These are all spring fed. The aquifer's general direction is from the northwest to the southeast, which would be Boone proper. There may be infiltration of any type of a contamination from the processes into our existing springs. Now, I'll combine this with my conversation with the mayor from Boone, which happened this morning. He is primarily concerned with the monitoring of the said springs or subject springs, and he's concerned with the tardiness of the reports.

Response. Figure 4.10 of the DEIS does show that some of the groundwater appears to flow in a south-southeasterly direction. Infiltration of contamination, however, is considered to be an extremely remote possibility (i.e., in the event of a major accident). In the event of such an accident, any springs serving as sources of potable water that could possibly be affected would be monitored for contaminants.

WQ-9. The DEIS mentions (p. 4-13) that the use of local alluvial water to operate the facility may have an impact on the local agricultural community. The EIS states that this will be only a negligible impact; however, the basis for this conclusion was not discussed. Please clarify the potential impacts and why the impacts will be negligible to the agricultural community

Response. Wells in the terrace alluvial aquifer beneath PCD cannot pump amounts great enough to impact areas long distances from the well because the aquifer is thin, generally less than 30–40 feet in thickness, and the wells therefore would go dry. The region of the aquifer immediately down-gradient (south) of the production wells could be affected; however, this portion of the aquifer terminates on the bluffs south of PCD in a series of seeps and springs. There would be no regional lowering of the water table due to groundwater use for destruction of chemical munitions. The region of the terrace alluvial aquifer affected by proposed groundwater withdrawals lies completely within the existing PCD boundary.

Under certain conditions, additional water may have to be purchased from other water rights holders. This would be done on a free market basis; thus, the water could come from any current water use in the water use area. This is also true of drought conditions; water would need to be purchased from holders of senior water rights. The only water users that would be affected by groundwater withdrawals would be those who voluntarily sell or lease their water rights to the project. During any period in which such water is used by the project, that water clearly would not be available for other uses such as crop irrigation.

WQ-10. The DEIS states (p. 4-87) that the Depot has a wastewater lagoon with an NPDES permit that allows discharge to Boone Creek at a rate of 167,000 gal/d. Yet it appears that PCD does not have an NPDES permit and the lagoon is non-discharging. This discrepancy should be resolved in the FEIS.

Response. Colorado is an NPDES-delegated state with EPA-approved permitting authority. Any wastewater or storm water discharges from a chemical munitions destruction facility at PCD would have to comply with CDPHE water discharge regulations (5 CCR 1002). PCD holds a NPDES permit for the discharge of treated water from the existing interim corrective action groundwater remediation system (ICAGRS) (NPDES Permit CO-0034673). PCD once held a NPDES permit for the sanitary treatment plant. This facility is no longer in service, however, and the permit was allowed to lapse in 1999 (Cain 1999). The destruction facility evaporation lagoon for sanitary wastes is non-discharging.

WQ-11. PCD has water rights to extract 1,000 acre-ft/yr from seven supply wells. The DEIS projects an up to 46% increase over the quantity of water being currently withdrawn from wells. While the EIS looks at impacts to the groundwater as a resource, it does not adequately address how this will impact current corrective action treatment systems already in place at PCD. Nor does it break out the possible differences between how different destruction alternatives may affect groundwater that PCD is currently attempting to remediate. Although the DEIS mentions the solvent plume going off-site from PCD and the associated Order on Consent, it does not acknowledge the explosives products plume that has left PCD and impacted many agricultural and domestic wells and one public drinking water supply well. We suggest doing a more detailed analysis of the effect of the withdrawal of water will have on the existing treatment systems on an alternative by alternative basis. This is especially important because several of the compliance wells are very close to applicable limits and even slight changes in water quantity might put PCD into non-compliance with the Order on Consent.

Response. The text is incorrect in stating that water withdrawals will increase by as much as 46%. The withdrawal rates to support chemical munitions destruction would be as high as 75 acre-feet/year, compared to only 4.3 acre-feet/year (not 150 acre-feet/year) under existing conditions. The text in Sect. 4.13.1.4 of this FEIS has been corrected.

The terrace alluvial aquifer does not directly connect with either the Chico or Boone Creek aquifers (The ICARGS and other remediation wells are all in the Chico Creek aquifer). The terrace alluvial aquifer ends on the bluffs surrounding PCD in a series of seeps and springs. Some water from these seeps and springs moves through the slopes to the lower more productive aquifers, but the amount is small. Given (1) the time period of construction and operation, (2) the amount of water withdrawn, and (3) the distance of the remediation facilities from the production wells (about 7 mi), it is unlikely that changes in the groundwater flow at the southern end of PCD (the outcropping of the aquifer) would be noticed. Finally, water use by a chemical munitions destruction facility would be significantly below historical PCD peak uses which occurred in 1983, and which showed no measured impacts to the Chico or Boone Creek aquifers. Also see the response to Comment WQ-9.

Text in Sect. 4.13.1.3 of this FEIS addresses the explosive products plume and its effects.

WQ-12. Colorado is a peculiar state when it comes to water terms. Water that is “consumed” does not return to the water basin to be used by someone else. It is gone for all intents and purposes. Water that is “used” could indeed return into the supply for use or consumption by a downstream user. Both documents need to clearly reflect the difference between used and consumed water.

The DEIS documents are unclear as to whether the recycling of water is taken into consideration in determining the amount of process water needed for the non-incineration technologies. Some statement concerning water recycling and an approximate percentage of recycling anticipated for these technologies would be most helpful in determining the total amount of process water to be consumed and/or used.

Response. Water use terms in the EIS reflect common English usage, not legal terminology. The term “water use” reflects the amounts of water needed for a chemical munitions destruction plant. With the exception of domestic sewage outfalls, this water is all “consumed” in the legal sense as it is not returned to the local environment. At PCD, all water is consumed, as the sewage treatment system is not expected to produce an outfall. The ACWA Technical Resource Document (May 2001) provides details on all water use, consumption, and recycling.

Water recycling is not proposed to be used in the modified baseline technology. Process water is primarily used in the destruction process for quenching the furnace exhaust and neutralizing acid gases. The clean liquor in the pollution abatement system is recirculated. Most of the process water will be contained in the brine or released as steam in the stack gases.

WQ-13. Regarding groundwater, both DEISes indicate that the terrace alluvial aquifer located under PCD and the Arkansas River Valley aquifer are not hydraulically connected. Yet, both cite the Rust, Inc. (I 997) report that found some connection between aquifers in a narrow alluvial channel near Unnamed Creek in the south central portion of PCD. The information in the Rust, Inc. report should be fully discussed and evaluated for impacts to groundwater. Both DEISes indicate that if necessary they will purchase additional water for the operation of the facility. However, the Department of the Army owns "junior" rights. In a drought season, they may not be able to withdraw additional water. The DEISes do not indicate what would happen in this situation. Both DEISes do not address the possibility of an impact of operation being the lowering of the water table. Should this occur how is Department of the Army going to reimburse those affected?

Response. The connection noted in the Rust, Inc. (1997) report is important in the context of that report, transport of contaminants off-post from historical contamination. This connection does not provide significant amounts of flow between the two aquifers. Also see the response to Comments WQ-9 and TAE-4.

Regarding the comment’s claim that the DEIS does not address operational impacts on the water table, Sect. 4.13.4 of the DEIS does address this issue.

WQ-14. Neither DEIS mentions in detail the most recent groundwater contamination clean-up efforts currently underway at the Depot.

Response. The most recent groundwater clean-up efforts are discussed in Sect.4.13.1.3 of this FEIS.

WQ-15. The DEIS states (p. 4-86) that “PCD's current water supply is a mixture from 11 water supply wells.” Line 24 on the same page states, “Current water use is approximately 185,000 m^3/year from seven water supply wells.” Clarify how many water supply wells are in use at the facility.

Response. The text has been revised to indicate that the Depot has eleven wells and water rights to extract 1,000 acre feet from seven, but is currently only using four wells.

WQ-16. The Arkansas River is not the only source of drinking water for the City of Pueblo in the traditional sense. The sources of the City’s water are both the Colorado River Basin and the Arkansas River Basin. The Arkansas River is used to convey water from both basins to the City’s intake. The water from the Colorado River Basin was discussed previously as transmountain water under the water supply issue.

Response. Section 4.20.1 in this FEIS has been revised to reflect this comment.

WQ-17. The Authority encourages the construction of a detention pond instead of a retention pond. The detention pond should be designed to discharge at the historic (pre-construction) rate of flow.

Response. No discharge is currently planned for the evaporation ponds.

K.3.13 Minor Revisions and Clarifications

Many commenters pointed out areas of the DEIS that require minor changes or clarifications. In addition to suggesting editorial changes (e.g., typographical errors, revisions to figures), the commenters asked for minor revisions that would help the clarity and readability of the documents. Comments in this category do not result in broad substantive changes in the DEIS, but they do help to improve the DEIS by correcting small errors, oversights, or ambiguities in the text. Minor changes have been made throughout this FEIS in response to these comments.

K.3.14 Out of Scope Comments and Comments Noted

The purpose of an EIS is to provide information on the potential environmental impacts associated with a proposed action and to aid in the decision-making process of an agency. The scoping and public comment processes are the mechanisms for identifying the issues, impacts, facts, and alternatives that should be considered in the EIS. During those processes, some of the comments that are offered may be related to the proposed action; but they have no direct bearing on the evaluation of the proposed action or alternatives. These comments include, for example, statements of opposition or support for a proposed action. The comments and opinions offered by the public are noted and appreciated. However, because they do not influence the assessment of potential impacts, they are responded to with “Comment noted.” The following comments are examples of statements that received the “Comment noted” response:

- *Given that emissions are predicted to be so much lower from the Neutralization alternatives (p. 3-23), it would take some significant decreases in Cost and Schedule, increases in Safety, for Baseline Incineration or Modified Incineration to be considered a viable alternative for PCD. The data presented in either DEIS do not show either Incineration alternative to be a clear winner based on any criteria.*
- *In the section discussing closure of the facility, the report states that decommissioning activities are planned, engineered, and implemented through the use of Engineering Change Proposals. Please be aware that any changes made to the closure plan will need to be reflected in the permit through the appropriate permit modification.*

In addition, not all issues, impacts, facts, or alternatives are relevant to a decision about a particular proposed action. Comments that present opinions or issues not appropriate or relevant to the proposed action or other reasonable alternatives are considered to be “out of scope.” Again, however, these comments are noted and appreciated; and their lack of relevance to the EIS does not indicate that they are dismissed without consideration or that they lack value. Also, some of the out of scope comments, although not relevant to the EIS decision, may be appropriately raised in other venues, such as the public involvement process associated with facility permitting.